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THE TELEGRAPHIC JOURNAL AND

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ELECTRIC LIGHT APPARATUS.

The interest felt by all classes in the introduction of the electric light for household purposes is now so universal that the one great question is, "When shall we be able to have this light in our houses?" At present this is rather a difficult matter to deal with, for, notwithstanding all that has been gone through by the Parliamentary Electric Light Committee, we are now at a standstill as far as any important operation is concerned towards solving the problem of domestic illumination. Several well-known gentlemen with unlimited funds have provided for themselves the necessary apparatus wherewith to light their own mansions by means of the incandescent electric lamps, the result, after the first cost, being eminently satisfactory; but the laying down of the necessary plant involves the outlay of a considerable sum, and it is this first expense which is keeping back many who would otherwise invest in a private installation of the electric light. It would really be worth the consideration of electric light companies to endeavour, by a different design, or proportioning of the various parts of dynamo-electric machines, to materially cheapen them, so that the evident desires of many private persons with tolerably good incomes could be met. M. Marcel Deprez has lately demonstrated, both theoretically and experimentally, that a magnetic field of given intensity is least expensive to obtain when it is produced by electro-magnets of considerable dimensions, and he recommends the employment of very powerful inducers surrounded with a *moderate quantity* (the italics are ours) of wire.

It is the wire for winding the bobbins and electro-magnets of these machines which constitutes the most expensive item in their construction, and we quite believe that the electro-magnets may be made much more cheaply and yet be equally as efficient as those now employed. As far as arc electric lamps are concerned, it is not probable that they will trench upon the subject of domestic illumination beyond a slight degree; but as they, too, have their special uses, cheapness in their construction is most desirable. Apparently the lamps of this type which have had the greatest sale have been the most costly, but it is easy to imagine that the demand for them would have been more than quadrupled had their price been reduced to one-fourth of their present scale. There is, however, every possibility of great reduction on this point, for there is, at least, one lamp lately brought before the public which can be made for a few shillings, and will last in action thirty or forty hours without recharging. Even presuming that the use of such a lamp entails the cost of 10 or 20 per cent. extra horse-power, its enormously reduced first cost and ease of manipulation will outweigh such consideration, more especially where the supply of power is unlimited. The question of consumption of carbon, and also of the manufacture of the carbon itself, is of the greatest importance. It will be seen, in the description of the illumination of the North Brussels Telegraph Office in our other pages, that of many experiments with retort and artificially-produced carbons, the best results were obtained with the former. Of course, gas carbon could not economically be used with the ordinary arc lamps; therefore, any system which can employ short and roughly-shaped pieces of gas carbon has a certain advantage over those which necessarily burn carbons artificially made. The manufacture of incandescent lamps has made more progress towards the end in view than any other part of an electric light system; and on the score of expense there is certainly but little to complain of, considering their lasting capabilities, when not forced beyond a normal illuminating power.

The expense attached to the employment of incandescent lamps has been reduced during the last twelve months about five times. This is due to a variety of causes, the principal being, perhaps, the fact that experimental work in this direction can be much more easily carried out than in the case when machines are the subject of investigation. In England, at least, we are deeply indebted to the labours of Messrs. Swan and Lane-Fox, who are practically the pioneers of this branch of electric lighting, and it should be remembered that, whatever improvements may have been made since by others, their path has been rendered easy by the labours of the two gentlemen mentioned.

The cost of conducting wires forms another heavy item in the sum total of a system of electric lighting, yet we have every reason to believe that this will be within a short period reduced nearly 50 per cent. The supply of gutta-percha and india-rubber as insulating materials is limited even now, and it is likely that their cost will be materially increased by the demands for electric light leads. It is therefore necessary that other materials be sought for to answer the same purpose, and this is in a very fair way of being satisfactorily accomplished. The motive power as supplied by steam engines for driving dynamo-electric machines is already established on as economical a basis almost as may be expected, but improvements in gas-engines will doubtless continue for some time to come. But it is not so much to improvements in the apparatus producing our motive power, as to the cheapening of the electrical part of the installation, that we must look to for the increased development of electric lighting. It is quite right and business-like on the part of any company with plenty of work in hand to keep up high prices; but it is no reason why new competitors in the same field should try to emulate the method adopted by the commercially successful company. It is the very object of competition to bring prices down to such a level that both manufacturers and the public receive their fair dues. It is necessary when the demand for certain articles is limited to charge accordingly, but when the demand is likely to become universal, it becomes policy on the part of those supplying the articles to encourage the desire of the public, and not to paralyse or stave it off by the exorbitant sums required for the apparatus. That the wished-for result will arrive sooner or later is a matter of course, but at present electric light companies, with one or two exceptions, show too much apathy towards the very object of their formation, and rapid progress therefore is scarcely to be looked for.

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... connected with them ... is formed of ... millimetres in ... three millimetres ... gutta-percha compounded

... of the Motor.

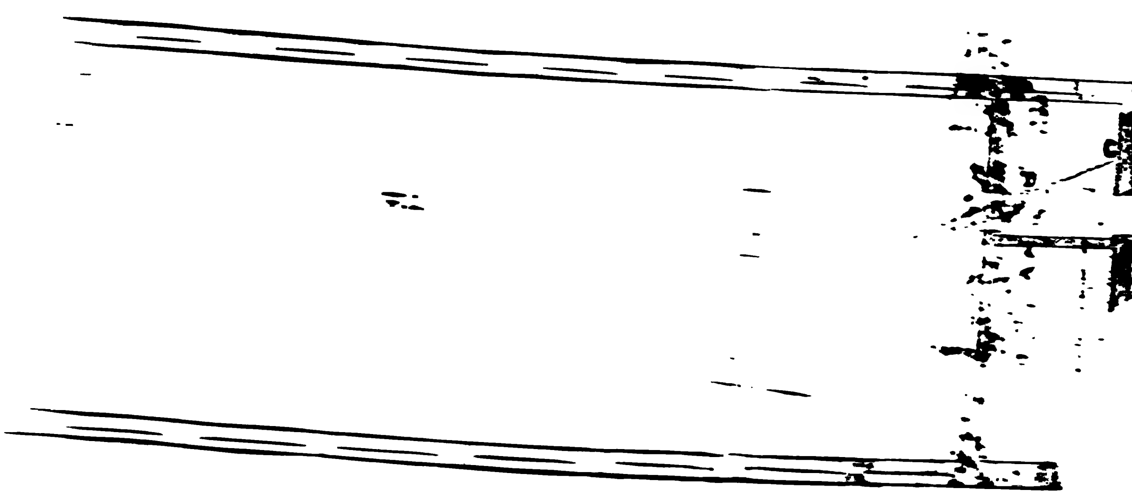
... Gramme machines, per- ... minute, and the number ... from forty to fifty. ... per minute.

... and 44 explosions it ... with 24°, 15; and ... with 25°, 15. If we ... in the first case :—

... = ... horse-power

... = ... horse-power.

... tends to raise the ... We may conclude, ... 5 horse- ...



... is supplied by ...

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... normal: the ...

... capable of ...

... dynamo-electric ... are still available. ... ventilator, ...

... Photometric ...

The measurements taken at different ... the luminous intensity of the ... gave, ... with the Bunsen photometer, ...

The standard candle ... call ... "Etoile," ... with a flame ... per ...

The photometrical results ... the

electric arc and the flame of the candle on the same horizontal line.

The maximum luminous intensity is obtained, with continuous current machines, when a straight line leading from the photometer to the arc makes an angle of 50 to 60 degrees with a horizontal plane.

Not having at our disposal a room sufficiently high to make our experiments under these conditions, we confined ourselves to taking the mean of the intensities. The experiments of M. Hippolyte Fontaine have shown that this average intensity is clearly equal to double that obtained when the arc, the photometer, and the standard light are on the same horizontal line (see *Revue Industrielle*, 9th July, 1879). According to these data, the mean intensity of the light obtained in the Jaspar regulators, burning Siemens' carbons (the positive having a central core, and the negative being of retort carbon), is 1,670 candles, the gas-engine making 160 revolutions and the dynamo-electric machines 955 revolutions per minute.

IV.—*Electric Measurements.*

The length of the circuits, including return wire, connecting the three Gramme machines to the three Jaspar lamps, are respectively 90·5, 120·7, and 140 metres. In order to measure the resistance in ohms of these lengths and that of the coils of the machines, we used a Wheatstone's bridge. After the cooling of the machines we found—

Designation of the Circuits.	Conducting Wires.	Coils of Electro-magnets.	Gramme ring	Solenoid of the Regulator.
First	0·44	0·65	0·88	0·086
Second	0·48	0·66	0·88	0·086
Third	0·53	0·72	0·84	0·086

The resistance of the carbons employed is 0·152 ohms for 0·22 metres of Siemens' carbons, and 0·175 ohms for 0·13 metres of retort carbon. It follows from this that if there had been no other resistance than those already enumerated, the current would have to pass through in each circuit at the commencement of the lighting respective resistances of 1·723, 1·773, and 1·873 ohms.

Each of the circuits, not including the dynamo-electric machines and the lamps, offers an insulation resistance of 55 megohms per kilometre.

When the gas-engine makes 160 revolutions and the Gramme machines 930 revolutions per minute, the intensity of the current measured by Siemens' electro-dynamometer varies between 15 and 16·6 ampères. We found by the method of discharging a condenser that the difference of potential at the terminals of the lamps is approximately 51 volts, and that at the terminals of the Gramme machine 57 volts. If we apply Joule's formula to these results—

$$\text{T} = \frac{\text{I}^2\text{R}}{9{\cdot}81 \times 75} \text{ horse-power.}$$

Where $\text{I} = 15{\cdot}8$ ampères

and $\text{R} = 1{\cdot}8$ ohms

we find $\text{T} = \dfrac{249{\cdot}64 \times 1{\cdot}8}{9{\cdot}81 \times 75} = \dfrac{449{\cdot}352}{735{\cdot}75} = 0{\cdot}61$ horse-power,

which gives us an available force of 24·4 per cent.

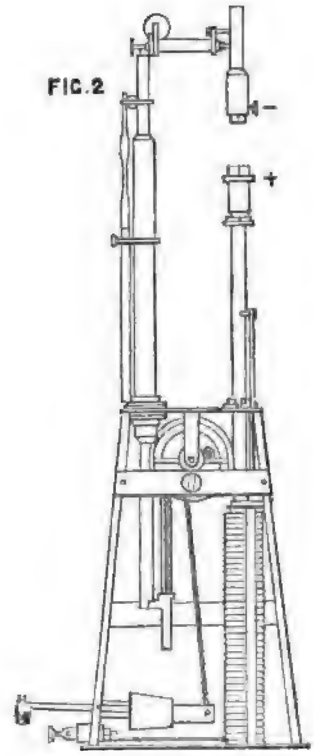
As it is to be supposed that there exists in the arc either an opposing electromotive force or a resistance the preceding formulæ should be modified as to the values to be given to R. This enables us to admit that the available force is greater than that which we obtain by calculation. We cannot, in fact, think that 75·6 per cent. of the effective work is absorbed by the motion of the machines and the heating of the wires.

V.—*Different Methods adopted for Lighting the Rooms at North Brussels.*

The first plan adopted for the lighting was to place three lamps on tripods at the points marked 1, 2, and 3, in fig. 1. In the three lamps, placed at a height of 2·75 metres, the positive carbon was underneath, so that the light was thrown on the ceiling and walls, partly directly, and partly by the help of a reflector, R (*see* figs. 2 and 2*a*). A cylinder, V, formed of sheets of glass, placed on the reflector, R, and a truncated cone of ground glass, G, obviated the projections of incandescent carbon. The globe, G, also prevented the light from striking directly on the eyes of those *employés* near the lamp.

By this method a light was obtained which was more than sufficient, but not very steady.

FIG. 2



This want of steadiness arises from the reverse employment of the lamp: the hollow, which is formed at the extremity of the positive carbon placed underneath, becomes filled with impurities contained in the carbon; these substances, on becoming fused, produce variations in the intensity of the light. This method of lighting was continued until the 15th

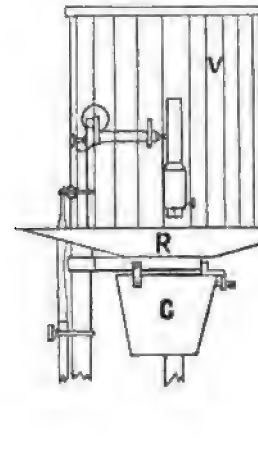


FIG. 2a

of February, 1880. At that date M. Jaspar modified the system by adopting a double reflection of the light. The positive carbon of the regulator was placed at the top of the lamp. (*See* figs. 3 and 4.) The light is reflected on the ceiling by horizontal mirrors, M, N, and M′N′, directed downwards. In order to hinder the full light from dazzling the operators, the luminous arc is enclosed in a truncated quadrangular pyramid, R, S, T, U, of sheet iron nickeled inside; the base of the pyramid is turned upwards. By

this means we obtained a very steady light, although the quantity of light utilised is not so great, on account of the reflection on the mirrors, as that resulting from the first method, it is still more than sufficient for the *employés* who attend to the telegraphic instruments. By using lamp No. 1, which belongs to the first room, we were able to light the little sorting room, which leads to the two instrument rooms. With this object the regulator of the first room (*see* fig. 5) bears a crown of six lenses, on which rests a horizontal

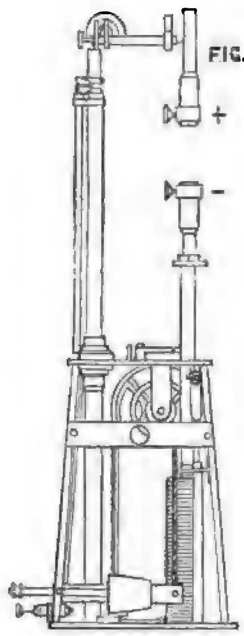


FIG. 3

nickeled reflector. The rays of the cone formed by the lenses are normal to those of the crater of the positive carbon. This arrangement allows of luminous sheaves being sent out by means of plane mirrors in six different directions. One of these sheaves is intercepted by another plane mirror, D (*see* fig. 1), which directs it on to a white blind, *b*, from which the light is reflected on to the pigeon-holes.

A second beam is directed to C, above the clerk who occupies the desk placed in this room. In order to prevent the luminous arc from dazzling the eyes it was enclosed in an elliptical truncated cone of sheet iron, nickeled inside. The luminous point occupies a focus of one of the horizontal sections.

VI.—*Experiments with different Carbons for Regulators.*

We tried the principal carbons known: the gas carbons, Carré's, Gauduin's, Siemens' coppered carbons, and those with central core, of Siemens Brothers, of different diameters. The majority of the artificial carbons gave bad results, the light changing frequently in intensity and colour. The best results were obtained with the gas carbons prepared with borax, and those of Siemens Brothers, with central core of plumbago, either used singly, or together with different diameters. The most advantageous combinations are the following:—

I. Two 9-millimetre square gas carbons.

II. Two square gas carbons, one of which, forming the positive pole, is 11 millimetres, and the other 9 millimetres.

III. A round carbon of Siemens Brothers, 14 millimetres in diameter, forming the positive pole, and a 9-millimetre square gas carbon, for the other pole. With a length of 22 centimetres for the carbon, which becomes hollowed out, and of 13 centimetres for the other (35 centimetres altogether), the first combination allows of an illumination of 3½ hours, and the two other combinations of 4½ hours.

VII.—*Attention required by the Apparatus.*

The daily attention required by the gas-engine is the same that necessary for all motors of the same kind.

The Gramme Machines.

The precautions to be taken in regard to these machines can be summed up as follows:—

1. The brushes should never be loosened while the current is established, because the spark which would be produced at the moment of their separation from the commutator, would burn the copper wires, of which they are composed.

2. The brushes should be moderately light, so that the pieces of bronze which support them may not rub against the commutator and wear it out. The wires of the brushes alone should rest upon it.

3. The position of the brushes being of great importance, it should be examined, and noted down at the time of the arrival of the machines, so that if shifted it may be re-established.

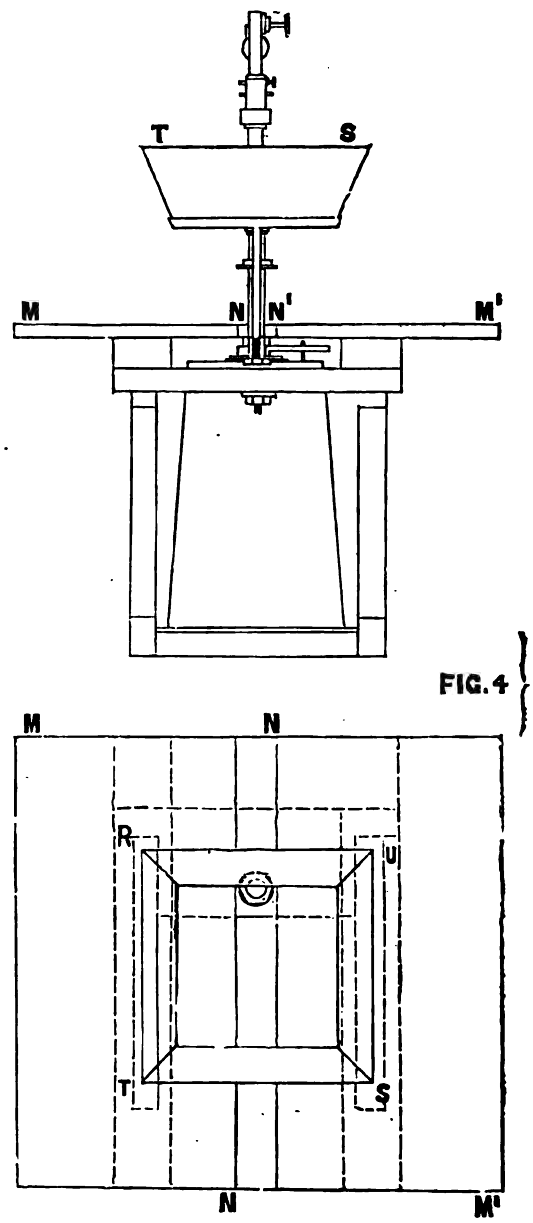


FIG. 4

4. If, by accident, the ends of the brushes should be burnt, the melted part should be cut off neatly, the brush should be pushed forward, so as to restore it to its original length, and then the ends should be filed, or sharpened so as to give them their former shape. Very few sparks should be produced at the point where the brush rubs against the commutator. Large sparks would indicate that the brushes are either badly placed, or not in good condition.

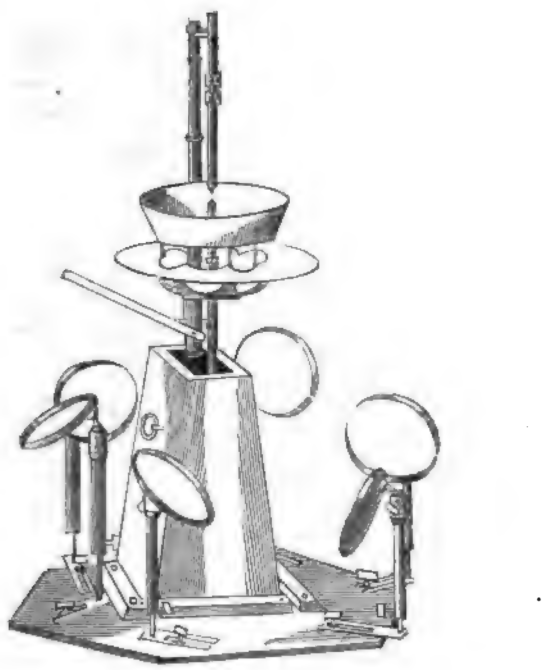
5. In order to avoid the wearing out of the brushes, it is advisable, now and then, to grease the commutator with a little oil on a rag, but care must be taken that the quantity of oil used is not sufficient to clog the brushes or to increase appreciably the electrical resistance of the circuit.

6. The driving-band should be kept tightly stretched.

7. All the machines should be in order before being put in motion. It may be ascertained whether the current is established by bringing a piece of iron near the ring at the top of the inductor; if it is attracted the current is circulating.

8. It is indispensable that the speed of the motor should be very regular; the bobbin of the Gramme machine should perform 900 to 1,200 revolutions per minute. If, after running about an hour, the dynamo-electric machine should

FIG 5



become heated beyond 100 degrees Centigrade, the speed must be lessened; if, on the contrary, the temperature does not exceed twenty or thirty degrees Centigrade, the speed must be increased.

The heating depends on the greater or less resistance of the wire connecting the machine with the lamp. The longer the wire is and the less its diameter the more its resistance increases, and, consequently, the more must the speed of the machine be increased.

9. The screws which fix the bobbin to the axle should be examined from time to time to see whether they have become loosened.

The Jaspar Lamp.

Fig. 3 gives an illustration of the Jaspar lamp. The lower carbon-holder is in electrical communication with the frame of the apparatus, and the other is completely insulated from it. The two carbon-holders are each guided by a vertical rod, which is fitted into a cylinder filled with mercury. Two cords, connnected by two pullies, the diameter of one being double that of the other, to the two rods supporting the carbons, regulate the distance between them, so that the distance traversed by the positive carbon is almost double that passed through by the negative carbon. A weight, which slides along a horizontal bar, is connected by a cord to a third pulley, fixed upon the axle of the two first.

The extremity of the rod of the lower carbon-holder, which is of soft iron, passes into a solenoid, which, by the magnetic attraction resulting from the passage of the current through its spirals, maintains a distance of three millimetres between the points of the carbons. When this distance is increased the intensity of the current is diminished, and the carbons come closer together. The object of the weight, which acts in an opposite direction to the electric current, is to enable the regulator to be employed for currents of very different intensities. The mercury in the two cylinders, in which are fixed the rods guiding the carbon-holders, prevents the sudden bringing together of the carbons, and insures good contact between the lower rod and the frame of the apparatus.

The lower part of the regulator is protected from the dust and from shocks by an envelope of varnished sheet-iron fixed to the woodwork of the apparatus by two screw-hoops, serving as handles for carrying about. The precautions to be taken in the manipulation of these regulators are as follows:—

I. Before starting them the rings should be unscrewed, the sheet-iron envelope taken off, raising it very carefully upwards, and 300 grammes of very pure mercury should be poured into the cylinders, taking care to move slowly the rod bearing the piston, in order to expel the air contained under it.

II. To make sure, before putting back the envelope, that the cords have not slipped from the grooves of the pulleys, and that the movable parts work quite freely. If everything is in order, and if the carbon-holders are drawn away from each other by pushing down the lower carbon, the two carbons should come slowly together, without jerk or break, as far as they can go.

III. The weight being drawn to the middle of the rod which bears it, the lamp is in readiness for the Gramme machine, revolving at 900 turns. The distance between the carbons during the action of the regulator is then 3 mm.

IV. To insure before lighting that no mercury has gone out of the cylinders, to work by hand the mechanism, and, if the movement of the carbon-holder is not regular, to clean the cylinder and its piston and filter the mercury through flannel.

V. To keep clean the rods of the carbon-holders by wiping them with a dry linen cloth, and if the apparatus has become clogged, to take it all to pieces and thoroughly clean the rubbing surfaces.

VI. In case the cords should break, to replace them by new ones, taking into consideration their respective lengths between the knots. These lengths are as follows:

For the large wheel	...	...	$0^{m}.260$
The next size ...	...	...	$0^{m}.185$
For the small wheel	...	...	$0^{m}.240$

VIII. The comparative cost of the lighting by gas and the lighting by electricity which have been used successively at the office of North Brussels.

A.—*Labour and Consumption of Material.*

Before the employment of the electric light, the large instrument-room was lighted by 47 gas-jets, the smaller one by 21, and the room leading into them by 2—or, altogether, 70 jets—each consuming 140 litres per hour. The total consumption was, therefore, $9^{m3}.800$ per hour.

This being at the rate of 0.15 fr. the cubic metre, the expense amounted to 1.47 fr. per hour for the complete lighting of the three rooms. To this price we must add 0.15 fr. for the glass chimneys and smoke-consumers, which brings it up to 1.62 fr.

In working the three Gramme machines, the gas-engine consumes about 8 cubic metres of gas per hour, which costs 0.15 fr. $\times$ 8 = 1.20 fr.

The lubricating of the Otto motor take half a litre of oil per day. The management of the machine and lamps is intrusted to one man, who receives a monthly salary of 120 frs., or 4 frs. per day.

The arrangement of the wires and telegraph instruments at the office of North Brussels necessitates the burning of gas all through the night. After 9.30 p.m. only a few of the instruments are used for the transmission and reception of despatches; at 11 o'clock, when the night service commences, this number is still less. The instruments at work after that time are scattered in various parts of the two rooms. The operators then require for their work a limited amount of light, easily obtained by lighting a few gas-jets.

As on the shortest days six hours of electric lighting are required (from 3.30 to 9.30 p.m.), and on the longest two hours (from 7.30 to 9.30 p.m.), we have on an average a duration of four hours. It is upon this average that we calculate the cost of the three lamps.

The total length of the carbons used with the Jaspar regulator does not exceed $0^{m}.35$, $0^{m}.22$ for the positive carbon, and $0^{m}.13$ for the negative.

By burning gas carbons 9 millimetres square, or gas carbons 11 millimetres square for the positive pole and

9 milimetres for the negative, or else Siemens Brothers' round artificial carbons with central core, 14 millimetres in diameter for the positive pole, and gas carbons 9 milimetres square for the negative, we arrive at the following results :—

In one lamp we burn, in 3½ hours, $0^m.35$ of gas carbon 9 millimetres square; in 4½ hours $0^m.22$ of gas carbon 11 millimetres square and $0^m.13$ of gas carbon 9 millimetres square; in 4½ hours $0^m.22$ of Siemens Brothers' round carbons, 14 millimetres in diameter, and $0^m.13$ of gas carbon 9 millimetres square.

If we bring this rate of consumption to an average duration of 4 hours, we find that we burn :

I. $0^m.40$ of carbon, 9 millimetres square.

II. $0^m.20$ of gas carbon 11 millimetres square, and $0^m.12$, 9 millimetres square.

III. $0^m.20$ of Siemens Brothers' carbons, 14 millimetres in diameter, and $0^m.12$ of gas carbon, 9 millimetres square. From these data, it follows that the cost of labour and consumption of material in producing the electric light by means of three Jaspar lamps, for 4 hours, can be estimated as follows :

	Frs.
Carbon...	2.24
32 cubic metres of gas at 0.15 fr.	4.80
½ litre of oil, rags, &c.	0.75
Salary of workman	4.00
Total ...	11.79

Or 2.95 frs. per hour.

We have already found that the cost of consumption with lighting by gas amounts to 1.62 fr. per hour.

B.—*Cost of the two Methods of Lighting.*

The cost of a complete installation of gas-pipes, meter, &c., such as that used at the office of North Brussels, may be estimated at 50 frs. per burner. The seventy burners used in three instrument-rooms cost, therefore, for installation, 70 × 50, or 3 500 frs.

For lighting by the electric light we have, for the cost of installation :—

	Frs.
3 Gramme machines, workshop type	4,500
3 Jaspar regulators	840
3 tripods of variable height	74
3 commutators	81
350 metres of insulated wires and cable	350
Accessories for the regulators	300
An eight-horse gas-engine	5,970
Fixing of the motor and instruction of workman ...	650
Total ...	12,765

Calculating the interest and repairing in the proportion of 10 per cent., we get, in the two cases :—

a. For gas : 0.96 fr. per day, or 0.24 fr. per hour of lighting.

b. For the electric light : 3.49 fr. per day, or 0.87 fr. per hour of lighting.

The actual cost of lighting per hour amounts, therefore :—

I. For gas : to 1.86 fr.

II. For the electric light : to 3.82 frs.

Thus, the electric light costs 2·05 times as much as gas.

If we take into account the luminous intensity, we find that one candle-power per hour of gas costs 0.0035 fr. (one gas-jet being equal to 7½ candles), and one candle-power per hour of electric light costs 0.00076 fr.; *i.e.*, 4 6 times less than gas.

IX.—*Concluding remarks.*

In rooms like those in which the telegraph instruments are placed at North Brussels, where the ceiling is low and the number of *employés* somewhat numerous, the use of gas for lighting seriously affects the health of the occupants. Gas vitiates the air by transforming part of the oxygen into carbonic acid, and also by heating it excessively.

The electric light presents none of these inconveniences : very little oxygen is absorbed, and the temperature is not appreciably raised. The work is performed about as easily as by daylight, the reading of the slips is rendered easier, and the operators are not so fatigued, all of which is very advantageous for the regularity and celerity of the service.

We give an extract from a letter addressed to the Administration by M. le Percepteur of North Brussels, January 12th, 1880 :—

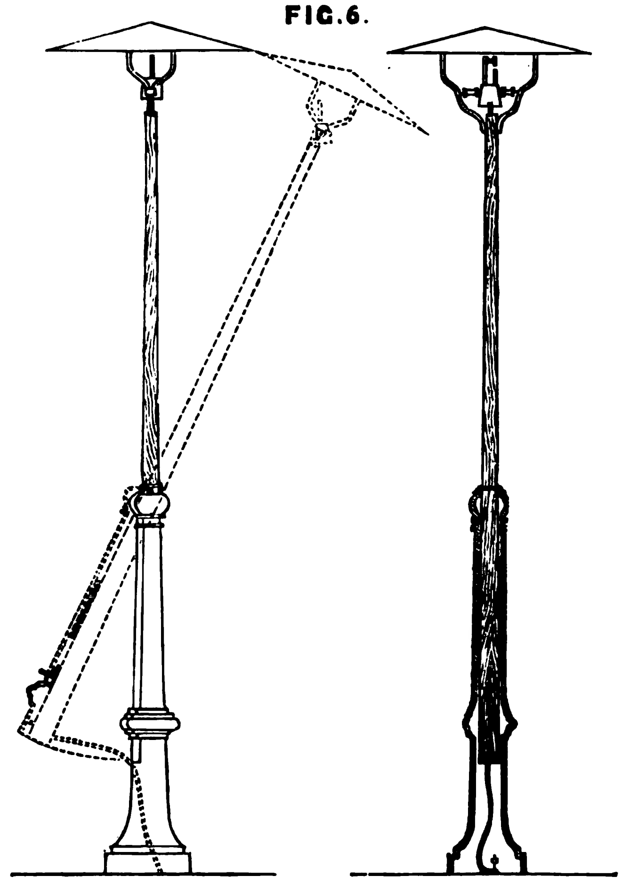
> Thanks to the light produced, which is almost equal to daylight, the work is performed with less fatigue than by gas-light, and the operators who, during the winter, pass seven hours after dark at the office, find themselves much fresher after their work than usual. The temperature of the room is no longer that of a furnace, as was formerly the case. We have received no complaint about the adoption of the electric light from any of the *employés*, and it is a great disappointment to them when it cannot be employed.

X.—*The Lighting of a Public Place.*

The success of the electric light at the Telegraph Office at North Brussels decided the Administration of Railways to attempt, in co-operation with the parochial authorities of Saint-Josse-ten-Noode, a trial of lighting, opposite the principal entrance of the Northern Railway station.

For this purpose a gas-engine of eight horse-power was installed to work three Jaspar regulators, destined to light the space opposite the station. The three lamps were placed at

FIG. 6.



a height of about 9 metres, one in the middle of the *façade* of the station, on the building itself; the two others in the Place des Nations, so that the light should be shed equally over the space to be lighted.

Each lamp is surmounted by a reflector of whitened sheet-iron, of conical shape. Behind the regulator, placed on the station, is a reflector composed of two plane mirrors, which send the light towards the centre of the space. The three burners are enclosed in globes of alabaster glass, which diffuse the light around.

The two regulators in front of the station are placed on candelabra, shown at fig. 6. A bracket, to the extremity of which the lamp is suspended, turns on an axle, and thus enables the carbons to be renewed. The two parts of the bracket are equalised so as to be easily managed. The plinths of the candelabra are of cast-iron.

The lamp has a divided axle, the two ends of which are inserted into pivots fixed to the candelabrum, and thus it can swing during the descent of the bracket.

The three Jaspar regulators are advantageously substituted in lighting the Place des Nations and the approaches

to it for 20 ordinary gas-lamps, consuming 200 litres per hour, and two Sugg burners, consuming 1,400 litres per hour.

The cost of the two methods of lighting can be estimated as follows:—

INSTALLATION.

I.—Of the electric light.

	Frs.
3 Gramme machines, workshop type	4,500
3 Jaspar regulators	840
3 commutators	60
Wires and underground cable	550
2 candelabra	320
Accessories for the lamp on the building	100
An 8 horse-power gas-engine	5,970
Total ...	12,340

II.—Of gas.

	Frs.
20 Ordinary gas lamps, with burner	3,000
2 " " with Sugg burner... ...	1,200
Total ...	4,200

The cost of labour and consumption of material, supposing the duration of lighting to be six hours per day, amounts to:—

	Frs.
Carbons for regulator	3.36
48 cubic metres of gas at 0·15 fr.	7.20
Oil, rags, &c.	0.75
Salary of workman	4.00
Total ...	15.31

or 2·25 frs. per hour.

The cost of consumption of material with lighting by gas amounts to 1·02 fr. per hour.

The cost per hour is, therefore, as follows:—

I.—Electric light.

	Frs.
Interest and repairing of installation, at 10 per cent.	0.56
Labour and consumption of material	2.55
Total ...	3.11

II.—Gas.

	Frs.
Interest and repairing of installation, at 10 per cent.	0.19
Gas consumed	1.02
Total ...	1.21

Under these conditions, the price of lighting by gas is 2·57 times less than that of lighting by electricity. If we calculate, as before in the lighting of the office, the cost per candle-power per hour, we should find that the electric light is much more economical than gas.

FIRE RISKS FROM ELECTRIC LIGHTING.

RULES and regulations for the prevention of fire risks arising from electric lighting, recommended by the Council of the Society of Telegraph Engineers and of Electricians in accordance with the report of the committee appointed by them on May 11, 1882, to consider the subject.

Members of the committee.—Professor W. G. Adams, F.R.S., vice-president; Sir Charles T. Bright; T. Russell Crampton; R. E. Crompton; W. Crookes, F.R.S.; Warren De la Rue, D.C.L., F.R.S.; Professor G. C. Foster, F.R.S., past president; Edward Graves; J. E. H. Gordon; Dr. J. Hopkinson, F.R.S.; Professor D. E. Hughes, F.R.S., vice-president; W. H. Preece, F.R.S., past president; Alexander Siemens; C. E. Spagnoletti, vice-president; James N. Shoolbred; Augustus Stroh; Sir William Thomson, F.R.S., past president; Lieut.-Colonel C. E. Webber, R.E., president.

These rules and regulations are drawn up not only for the guidance and instruction of those who have electric lighting apparatus installed on their premises, but for the reduction to a minimum of those risks of fire which are inherent to every system of artificial illumination.

The chief dangers of every new application of electricity arise mainly from ignorance and inexperience on the part of those who supply and fit up the requisite plant.

The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing" or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are, either ordinarily or for the purpose of testing, passed through the circuit. Bare or exposed conductors should always be within visual inspection, since the accidental falling on to, or the thoughtless placing of other conducting bodies upon, such conductors might lead to "short circuiting" or the sudden generation of heat due to a powerful current of electricity in conductors too small to carry it.

It cannot be too strongly urged that amongst the chief enemies to be guarded against are the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger.

The chief element of safety is the employment of skilled and experienced electricians to supervise the work.

I. THE DYNAMO MACHINE.

1. The dynamo machine should be fixed in a dry place.
2. It should not be exposed to dust or flyings.
3. It should be kept perfectly clean and its bearings well oiled.
4. The insulation of its coils and conductors should be perfect.
5. It is better, when practicable, to fix it on an insulating bed.
6. All conductors in the dynamo room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II. THE WIRES.

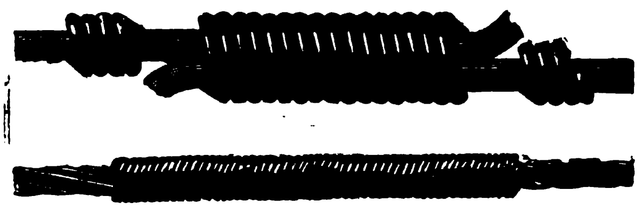
7. Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left to itself it cannot permit of a permanent arc or of heating, and its stand should be made of slate, stoneware, or some other incombustible substance.
8. There should be in connection with the main circuit a safety fuse constructed of easily fusible metal which would be melted if the current attain any undue magnitude, and would thus cause the circuit to be broken.
9. Every part of the circuit should be so determined, that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and changes of circuit, from a larger to a smaller conductor, should be sufficiently protected with suitable safety fuses so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150° F.

N.B.—These fuses are of the very essence of safety. They should always be enclosed in incombustible cases. Even if wires become perceptibly warmed by the ordinary current, it is a proof that they are too small for the work they have to do, and that they ought to be replaced by larger wires.

10. Under ordinary circumstances, complete metallic circuits should be used, and the employment of gas or water pipes as conductors, for the purpose of completing the circuit, should in no case be allowed.
11. Where bare wire out of doors rests on insulating supports, it should be coated with insulating material, such as india-rubber tape or tube, for at least two feet on each side of the support.
12. Bare wires passing over the tops of houses should never be less than seven feet clear of any part of the roof, and they should invariably be high enough, when crossing thoroughfares, to allow fire escapes to pass under them.
13. It is most essential that the joints should be electrically and mechanically perfect. One of the best joints is that shown in the annexed sketches. The joint is whipped around with small wire, and the whole mechanically united by solder.
14. The position of wires when underground should be efficiently indicated, and they should be laid down so as to be easily inspected and repaired.

15. All wires used for indoor purposes should be efficiently insulated.

16. When these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses like iron girders or pipes, they should be thoroughly protected from abrasion with each other or with



the metallic masses, by suitable additional covering; and where they are liable to abrasion from any cause or to the depredations of rats or mice, they should be efficiently encased in some hard material.

17. Where wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the wires cannot be too strongly urged. It is an operation, skill in which is easily acquired and applied. The escape of electricity cannot be detected by the sense of smell, as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering, by electric action.

III. Lamps.

18. Arc lamps should always be guarded by proper lanterns, to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. Their globes should be protected with wire netting.

19. The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV. Danger to Person.

20. To secure persons from danger inside buildings, it is essential so to arrange the conductors and fittings, that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there should never be a difference of potential of more than 200 volts between any two points in the same room.

21. If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

By order of the Council,

F. H. WEBB, *Secretary*.

THE BAUDOT TELEGRAPH.

(Sixth Article.)

Combiner (*continued*).—We shall now describe the combiner according to the practical form which it takes in M. Baudot's last models.

Fig. 7 shows the plan. We see ten concentric rings, representing the five pairs of grooves (normal and complementary), distinguished one from another by different signs. The shaded parts correspond to the projections and the white to the hollows. It must be borne in mind that an immense number of similar tables could be compiled, since, with the five effects necessary to form a signal, we obtain for our computation the product $1 \times 2 \times 3 \times 4 \ldots\ldots \times 29 \times 30 \times 31$. We will confine ourselves to the table chosen by the inventor.

In this table the projections and hollows do not occupy the entire circumference. A sector, equal to $\frac{13}{78}$ths, is reserved for the insertion of fixed stops, placed on the complementary grooves or those in action, and represented in black on the diagram. These stops serve for the pointing. The needles occupy $\frac{5}{78}$ths in this sector. When at rest the needles close the groove of action, and the rubbers then follow the grooves of rest; the frame does not fall, and no impression is made. The two grooves of each rubber are separated by a partition which prevents it from passing into the groove of action before having been directed there by the needle. There is no partition in the sector reserved for the pointing; the change of direction can be effected at this part only. The two grooves of one rubber are separated from the next by a partition extending all round the circumference. Besides the ten rings represented in fig. 7, we see an eleventh which encloses the others. It is equally divided into projections and hollows. These divisions are distributed in such a manner that the hollows always project over the spaces in the first groove of action. An examination of the figure will clearly show the advantage of this arrangement. The movement of the chariot bearing the five normal runners being determined in the three pairs of grooves according to the pointing, if the chariot has a sixth runner specially designed for this supplementary eleventh groove, the result will be that the fall of the frame brought about by the formation of the combination (say, five hollows) will only take place when the rubber itself corresponds to a space. We thus do away with one cause of deterioration which would otherwise lead to the rapid wearing out of the grooves of the table and of the collectors every time a change is made from a hollow to a projection after the production of a combination. The transfer is made only on one ring and one collector.

Fig. 8 shows the details of the combiner, and the arrangement of the hollows and projections corresponding to the letters of the alphabet. Above this is shown the system of the five rubbers (the sixth, before mentioned, is omitted, as it has no connection with the pointing). The five rubbers are fixed vertically and movable on a pivot horizontally. They support a frame which is constantly drawn down by a spring, *v*.

If the explanations already given are referred to, it will be seen how the displacement of a rubber is equivalent to the substitutions we had imagined in order to explain the formation of the combinations. The needle being actuated will close the entrance of the groove of rest, and direct the rubber into the groove of action. If the first needle is displaced in the forward movement of the frame, the first rubber will follow the groove of action, and the four others will remain in their respective grooves of rest; at the first division, a space coming under each of the five rubbers simultaneously, the frame will fall.

With the displacement of the second needle, the fall of the frame will take place at the second division, and so on for each of the combinations. The function of the frame is, in short, that of a collector seeking the place where it is to fall, a point always determined by the combination corresponding to the letter to be printed.

We will now consider the mechanism of the pointing. In the first brief description we said that the five keys of the manipulator at the post of arrival corresponded to the five electro-magnets, the armatures of which repeated the combination formed by the keys. We see, therefore, how the movement of these armatures can be utilised for affecting the action of the needles. In reality the line current does not act directly on the electro-magnets; it puts in motion relay which works them by a local current. The description of the relay employed by M. Baudot will be given subsequently; we shall first explain how the movement of the armatures of the pointing electro-magnets is transmitted to the needles.

The five electro-magnets are fixed against a plate in the apparatus. At the moment when the local current passes into an electro-magnet the armature is attracted, and, pressing against one extremity of the rod, *t* (fig. 9), enables it to push the appendage, *a*, of the lever of the needle. An index, *i*, of thin sheet-iron, fixed on the screw, *v*, of the armature and outside the plate, enables the movement of the armature to be controlled.

When the pointing electro-magnet is no longer influenced, the armature is brought back to rest by the rod [illegible] actuated by the spring, *v*. The needle is maintained in the app[illegible] position in which it has been placed by means of a rolle[illegible] fixed to a

THE TELEGRAPH ENGINEERS' SOCIETY AND THE ELECTRIC LIGHT.

WE cannot congratulate the members of the committee, appointed by the Society of Telegraph Engineers and of Electricians to investigate the fire risks attached to the employment of the electric light, in having produced a report which can in any way be considered superior to that brought forward some time since by Mr. Heaphy, C.E., for the guidance of the Phœnix Fire Office. As a matter of fact, this gentleman's single-handed production deals more exhaustively with the entire subject than does the meagre amount of matter collected by the committee of the Telegraph Engineers' Society. We cannot think that the majority of the gentlemen named had any hand whatever in framing this report, or the result would have been more worthy of their reputation. We would undertake to say that, had Professors Ayrton and Perry been commissioned to draw up a report on this important subject, we should have had, at least, something material added to our present knowledge, and many valuable suggestions, which would not probably occur to those whose minds and time are actively engaged in daily practical work, would have been brought forward.

One would naturally have expected, not necessarily a voluminous amount of matter from this committee, but at least sufficient information, embodied into the form of rules, as to be looked upon in the light of an authoritative and exhaustive treatise. Instead of this, we are treated to a mild and condensed account of what we should imagine everybody had read before. The six rules relating to the dynamo machine contain absolutely nothing but what every electrical engineer would do his best to arrange for. The information relating to the wires is not nearly so thoroughly treated as by Mr. Heaphy in the report above referred to; and although we did not see the force of some of the rules proposed by that gentleman, he had apparently been to a considerable amount of trouble in investigating the matter; and, in the end, produced a far more creditable attempt at efficiently dealing with fire risks from the electric light than the pamphlet before us.

In no part of this report is any suggestion thrown out as to any simple or convenient means of following up the outlined ideas of the Committee. The Society of Telegraph Engineers should be aware that the electric light engineer of the present day is in almost every instance a creation of the last three or four years, and that many hints which may be quite apparent to a professional electrician require a simple explanation or example to be of service to the latest comers in electrical work. For instance, if we take the following example it will illustrate our meaning:—Rule 15 reads, "All wires used for indoor purposes should be efficiently insulated." Now what will this convey to the mind of a man who does not know in what terms the meaning of insulation is expressed, or in what degree the different properties of insulating materials may vary. The only service which we can imagine this pamphlet will render towards the object in view is in the strongly-urged remark, that the chief element of safety is in the employment of skilled and experienced electricians and in the frequent testing of the wires.

As a recommendation from the Council of the Society of Telegraph Engineers and of Electricians the Report is utterly unworthy of the Society's reputation. The subject is merely touched upon, and that in the flimsiest manner, and although the intention of the Committee may have been a good one we can only come to this conclusion, that it has failed unmistakably in producing a work which will ever be looked upon as authoritative, useful, or containing anything whatever beyond that which electric light engineers already know. We are sorry that so many eminent men should have allowed this pamphlet to be brought forward with their sanction. England is looked upon by Continental and American electricians as the leading country in electrical science, but we do not think that any prominent body of engineers abroad would produce such a miserable offspring as that brought forth by the Society of Telegraph Engineers and of Electricians.

ARC ELECTRIC LIGHTS FOR LARGE INDOOR SPACES.

IN our columns of this week will be found an interesting description of the lighting of the telegraph office at North Brussels by the Jaspar system of arc lamp. Although this installation was commenced as long since as 1879, we have thought it sufficiently interesting to place before our readers for various reasons. In the first place, very little has been heard in England respecting the performance of the Jaspar system; and this, in connection with the mirrors and reflectors employed for equalising the light throughout large rooms, and the manner in which it was performed will, we feel sure, form a theme of general interest. In addition to the admirable way in which the lamps were disposed for the particular purpose assigned to them, the whole arrangement of the installation was carried out in a more minute and exhaustive manner than we remember to have seen either previously or since. Not a single point seems to have been omitted, and the experiment has more than a local significance as far as arc lamps are concerned, and the best carbons for employment therein. The nearest approach to the method of lighting adopted in the Jaspar system has been shown experimentally on several occasions, by Messrs. Siemens Brothers, who have thrown their light upwards, and thus allowed it to be reflected from the ceiling, or from suitably arranged reflectors, over a large space. But it is to the peculiar and ingenious arrangements of the mirrors and reflectors in the North Brussels Telegraph Office that we would call attention, for the large amount of light given by an arc lamp is there utilised to the greatest extent. As generally employed there is an enormous waste of light, and this matter has not yet been handled with a view of eliminating such loss. It has always appeared an odd thing, that after producing a certain intensity of light by means of a given current strength, we should at once reduce it one-half at least by enclosing the lamp in a thick opal glass globe. This may be perhaps essential in street lighting, but for factories and warehouses, it seems that such a device as that used at North Brussels might be profitably employed in England.

THE ELECTRIC NEWS-TELEGRAPH COMPANY.

UNDER the above title a new company has lately been brought before the public, which practically proposes to work in competition with the already established and well-known Exchange Telegraph Company. The latter, seeing that the base on which they stand is likely to be somewhat shaken, and the monopoly which they have hitherto enjoyed curtailed, seem to be doing their best to throw discredit upon the operations of their antagonist. The chief advantage which the new comers put forward as regards the instruments they intend to use is, that the apparatus only requires one wire to work it. The prospectus states that the apparatus "is remarkable for its simplicity, and is thoroughly reliable in action, the whole of its varied movements being regulated by one single wire. . . . The apparatus itself, which is small (and is almost silent in action), is fixed under a glass cover on a stand in the room or office of the subscriber, and by means of a paper tape contained within the machine, the news transmitted is printed in ink in large and legible characters upon the tape, both in words and in figures, without the intervention of any person whatever. . . . ." The machines have not any contact points, and are believed to be worked with some 60 per cent. less battery power than any existing instrument employed for a similar purpose. In a letter from Sir Charles Bright, the latter says: "The apparatus comprises several technical improvements of a novel and very ingenious character, one of which is a peculiar self-adjusting appliance by which the mechanism is brought into perfect unison at short intervals, precluding irregularity in working." This unison-adjuster, although referred to in the letter of Sir Charles Bright, is not claimed in the prospectus as one of the advantages of the system.

The Exchange Telegraph Company, in an advertisement

which they put forward, almost simultaneously with the issue of the prospectus of the new company, imply that this adjuster is put forward as one of the advantages of the new apparatus, and, moreover, they state that it is an infringement of a patent which is their own property. The Exchange Company further state that "they consider it an error to say that the whole of the varied movements of the instrument in question are regulated by a single wire, as they are partly dependent upon clockwork." They also say: "They have had in operation in London an electrical type-printing instrument for ten years, and although two wires are used for the purpose of giving quotations, this plan has been adhered to by them, and is universally used in America as being admittedly the best for recording the prices of stocks and shares." "The Exchange Telegraph Company have had for the same number of years more than one description of single wire type-printing instrument, with double the speed of any other single wire instrument in this country." The fact that a two-wire instrument has hitherto been considered to be better than one which works with one wire is, we think, hardly an argument that an equally good apparatus with one wire cannot be obtained, and the statement of the Exchange Company seems to imply that the apparatus which they used cannot be improved upon, except perhaps by themselves. The unison-adjuster is such an old idea comparatively that its protection by recent patents is, we think, open to question, unless the arrangement be a very special one, which, we rather fancy, is not the case in the Electric News Company's instrument. The use of clockwork, which enables the working battery power to be considerably relieved, is, in our opinion, no objection, but rather an advantage. We can hardly see by what argument the Exchange Company can say that the clockwork effects the "regulation" of the instrument; the clockwork is regulated, but it does not regulate. From opportunities we have had of seeing the working of the new instruments, we can testify to their efficiency, and to their compact form. The instruments of the Exchange Company, we know, are very efficient, but we cannot agree that their efficiency is so great, and that of the new company so small, as to render the use of the latter undesirable. The Exchange Company, feeling the pressure put upon them, and that their monopoly is slipping away from them, are naturally making every effort to prevent competition; but we doubt whether the statements which they have put forward will help them to any material extent.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

DYNAMO-ELECTRIC MACHINES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Mr. Riley's letter in your issue of July 1st, taken in the face of your footnote, hardly calls for an answer from me. Perhaps, however, Mr. Riley's mind may be set at rest if I tell him that neither I nor any other patentee can have any right or claim to the outward shape or form of the field electro-magnets of a dynamo machine.

As this appears to be the only point in which Mr. Riley claims any resemblance between the two machines, I trust that this explanation on my part may satisfy his *amour propre*. I am, Sirs,

Your obedient servant,

HENRY F. JOEL.

July 5th, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I have read the letter of your correspondent, Mr. J. S. Riley, in your issue of the 1st inst., in which he claims some similarity between his magneto-electric machine and that of Mr. Joel, and alleges that he showed me a photograph of his form early last year.

On looking over the visitors' book I find that a Mr. Riley visited the Library several times last year, and it is possible he may have shown me the photograph he refers to, but I am quite unable to say what were the principal features of his machine, or whether there is any similarity between it and the one to which it refers. I am not acquainted with either. Your note appended to Mr. Riley's letter renders any further remarks from me unnecessary.

I would add, however, that if Mr. Riley will examine the specifications of the principal dynamo-electric machines he will find *many* instances in which one machine is similar to another. I am, faithfully yours,

A. J. FROST,

Librarian, Society of Telegraph Engineers and of Electricians.

July 3rd, 1882.

NOTES.

THE ELECTRIC LIGHT IN THE CITY.—A considerable amount of correspondence is to be found on the subject of electric lighting in the *City Press* of Saturday last. The first is a lengthy and important letter from Mr. Alexander Peebles, in which he analyses the three lowest tenders received for each district to be illuminated. This gentleman bases his facts upon the report of the Commissioners of Sewers, the items of which appeared in the above paper in its issue of June 21st. (See ELEC. REV., June 24th.) There it was stated that the minimum charge for electric lighting in the four districts (three new, and the one vacated by Messrs. Siemens Bros.) was £9,930, as against gas £1,867 for the same area. This comparative estimate Mr. Peebles says is upon a wrong basis; hence his letter. In his tables the following data occur:—

District No. 1, comprising Newgate Street, Giltspur Street, Smithfield (S.E. and N.E. sides), Long Lane, Aldersgate Street (from Barbican to St. Martin's-le-Grand), and St. Martin's-le-Grand.—For lighting this district by electricity eight tenders were received, the three lowest being as follows: 6th, 1¾ per cent. more than gas; 7th, fully 5 per cent. less than gas; 8th, nearly 10 per cent. less than gas.

District No. 2, comprising Threadneedle Street (from front of Royal Exchange to Old Broad Street), Old Broad Street, New Broad Street (from Liverpool Street to London Wall), Liverpool Street (from New Broad Street to Bishopsgate Street), Bishopsgate Street (from Liverpool Street to Cornhill), and Cornhill.—For lighting this district by electricity seven tenders were received, the three lowest being as follows: 5th, fully 54 per cent. more than gas; 6th, fully 11 per cent. more than gas; 7th, fully 9 per cent. more than gas.

District No. 3, comprising Leadenhall Street, Aldgate, Aldgate High Street, Fenchurch Street, and Lombard Street.—For lighting this district by electricity seven tenders were received, the three lowest being as follows: 5th, fully 64 per cent. more than gas; 6th, fully 14 per cent. more than gas; 7th, fully 11 per cent. more than gas.

District No. 4, vacated by Messrs. Siemens Bros.—For lighting this district by electricity seven tenders were received, the three lowest being as follows: 5th, 17½ per cent. more than gas; 6th, 1¼ per cent. more than gas; 7th, 3¼ per cent. less than gas.

Upon adding together the estimated annual cost of the present gas light in these districts, it amounts to £1,867, whilst the four lowest tenders for the electric light amount to £1,863, but in this comparison gas has had the advantage of all the improvements in its manufacture which have been discovered since its introduction, and it is generally understood the gas companies do not regard street lighting as a source of profit, whilst electric lighting is, comparatively speaking, in its infancy, and in these tenders street lighting is alone included.

A second letter, by an anonymous contributor, relates to the apparent irregularity of prices charged for each district during last year's experiments, whilst a third emanates from W. J. Elliott, the gentleman who, on the strength of having tried to fire a gun by electricity, gives it as his opinion that the system of division and subdivision of the electric light as exemplified in the installation of Mr. J. B. Rogers is the best before the public.

In connection with the subject of private lighting we read in the *City Press* of Wednesday that at Tuesday's meeting of the Commission of Sewers—

The Clerk (Mr. Blake) read a petition from the Electric Light and Power Generator Company, and the Hammond Electric Light and Power Supply Company (Limited) stating: "That in tendering to

your Commission your petitioners have estimated that the lighting of the streets would be for one year only, and experimental in its character, and your petitioners have therefore been obliged to take into account that part of their plant and materials would be useless at the expiration of the year; but if your honourable Court see fit to give the light some permanency of character your petitioners would be able to make a lower tender. Your petitioners desire to point out that so far as regards the lighting of shops and warehouses they could do so by means of running cables into the shops and warehouses from the street. Your petitioners also desire to point out to the Commission that the lighting of shops and warehouses of private persons is a most remunerative undertaking, and if your Commission think fit to give to your petitioners and to the ratepayers the right of coming to an agreement with reference to private lighting *en route* your petitioners would be in a position to make a tender very much lower than they have hitherto been able to do." Mr. F. Green moved that the petition be referred to the Streets Committee, which was agreed to. A letter from the Pilsen Company to the same effect, and a petition from City merchants and traders, asking that the subject of private lighting by electricity might be speedily settled, were also referred to the Streets Committee for consideration and report.

"TRUTH" AND THE ELECTRIC LIGHT.—Of late a number of scathing, not to say worse, articles have appeared in *Truth* on electric light companies, chiefly attacking the Brush Company and the Sellon-Volckmar accumulator affair. An extract from the columns of this journal of June 29th reads as follows:—"The Brush Company, the most prolific and the most impudent of these companies, has for its vice-chairman Mr. Sellon, who, it has been proved, sold an utterly valueless 'patent' to a company for £340,000, and Sir Henry Tyler, who apparently makes a business by directorships, is its chairman." We think it is really time that these two gentlemen should take steps to defend themselves from these attacks, for the reputation of those associated with them, if not for their own sakes.

ELECTRIC LIGHT PATENTS.—We read in *Truth* that "not one vestige of evidence is adduced of the commercial value of the so-called patents." We do not quite see how the progress of electric lighting during the past four years could have so far advanced as we now see it in the present day had not the various patents taken out during this period presented some advantages over that which was public property anterior to these inventions. Surely if a man produces some *actual* improvement on what is known, and which improvement would by its adoption have a beneficial effect on any given system of electric light, he is entitled to some substantial reward as the result of his mental labour? If then any company can see that its operations will be assisted by the employment of something for which a certain sum is asked, it seems evident that the "something" has a commercial value. We will say, however, that sums have been paid utterly out of proportion to the actual value of the invention; but that does not seem to be the point at which *Truth* is aiming.

THE FYFE-MAIN ARC LAMP.—We hear on good authority that in addition to the six lamps already in operation at the new offices of the *Daily Telegraph*—and which, we are informed, give great satisfaction—Mr. Alexander Fyfe is busily employed in fitting up six more in the printing rooms, and that he will extend the system as far as his motive-power will allow, the engine at present supplying the driving power for the dynamo-electric machines being one by Marshall and of 10 horse-power nominal.

ELECTRICIAN WANTED.—We beg to call the attention of electricians to such advertisements, in case they might pass them by when first perusing our columns.

ELECTRICAL APPOINTMENT.—We are informed that Mr. A. F. A. Hervey, late assistant to Messrs. Woodhouse & Rawson, engineers and electric light contractors, has received the appointment of engineer to the Australasian Electric Light Company (Brush system), and he leaves on the 13th inst. for Australia. Mr. Hervey has the advantage of having made the subject his profession, and as he was for a number of years employed in India with the late Mr. Louis Schwendler, he has met with more than ordinary opportunities of acquiring knowledge in all branches of electrical science. We believe for the first eight months or so Mr. Hervey will be travelling through Australia and New Zealand with Sir Julius Vogel before beginning his practical work.

PERSONAL.—We believe that Mr. A. Le Neve Foster, who has been so long connected with the India-rubber, Gutta-percha, and Telegraph Works Company, of Silvertown, as chief of the instrument department, has now left that company and associated himself with a manufacturing company carrying on operations in the country. Mr. Foster is so well known amongst electricians that it is hardly necessary for us to say that anything he undertakes will be entered into with a thoroughness, and a knowledge of every part of his profession which will leave nothing to be desired. We shall be glad to hear of Mr. Foster's success in the future.

THE POST-OFFICE AND THE TELEPHONE.—It is brought to us on reliable authority that the Postmaster-General contemplates giving up the erection of private telephone lines, and as far as exchanges are concerned, the Post-office authorities will not interfere as long as their own interests are not invaded. It appears from this, therefore, that telephone exchanges, with but few exceptions, will soon be thrown open to all. Should this be true, a great impetus will be given to telephony, which is, comparatively, now almost at a standstill, albeit the telephone is the most wonderful invention of the age.

THE LONDON AND GLOBE TELEPHONE COMPANY.—Referring to the above note, it will be within the memory of our readers, that this company applied some time since for licences to open exchanges in many towns in England, amounting altogether, we believe, to some 160 or thereabouts.

TELEPHONIC COMMUNICATION WITH A CONGREGATIONAL CHURCH.—Telephonic communication (says the *Greenock Telegraph*) was on Sunday established between the residence of Mr. John M. Hutcheson, Thorndean, and the George Square Congregational Church, Greenock. The experiment was an entire success. Several persons in the Exchange, at Watt Place, heard the whole service quite distinctly, and even at Glasgow some passages of the Rev. J. M. Jarvie's remarks were written down and repeated to the people in the Greenock office, to show how clearly the sermon had been heard so far away. Mr. Hutcheson himself says that he did not miss a single word of the forenoon service, and that the musical part of the service was particularly well heard by him.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY'S CABLES.—We read the following in the *Panama Star and Herald* of June 8th:—

The cable of the West Coast of America Telegraph Company, from Mollendo to Chorillos, was successfully repaired in the early part of May, by their engineer, Mr. E. W. Parsoné, in the ss. *Retriever*. The break was off Point Pescadero, in about 800 fathoms of water. At that depth it was recovered with difficulty, rendered all the more so by a very singular circumstance. The country near the situation of the fractures, some 400 nautical miles or more South of Chorillos, is as barren of all kinds of vegetation, trees, or shrubs, as any part of the coast of Peru.

Notwithstanding this, the cable when raised to the surface, brought up great masses, tons in weight, of trunks, roots, and branches, apparently of well-grown olive and other trees. Here is a chance for some of our *savants* to tell whence came these trees, branches, roots, &c., so far from the shore, and in water nearly a mile deep. It cannot be accounted for by a submersion of any portion of the coast of Peru in any times known to history, since we have no such record. Nor have any notable land slides occurred by which such ligneous growths could have been swept from the land into the sea, to be imprisoned at its depths by the earth or portions of rocks still clinging to them. Probably in times of which history or Indian tradition make no note, in some convulsion of nature on that coast, so frequently stricken by earthquake or tidal wave, that portion of the coast was submerged and carried with it to the depths of the sea, the human beings who inhabited its lands, their dwellings, and their wealth, and the gardens and orchards they cultivated. At the depth at which these curiosities were found, decay would scarcely affect them.

THE POST-OFFICE CABLES.—The Post-office authorities have again chartered the London and Edinburgh Shipping Company's steamer *Morna* for the purpose of repairing their faulty cables in Shetland, and on the West Coast of Scotland.

TELEGRAPH CABLES.—In the House of Commons on Tuesday last Mr. Monk asked the Under-Secretary for Foreign Affairs whether Her Majesty's Government had

taken any steps, in concert with other nations, with a view to the protection and preservation of telegraph cables, and whether it was proposed to send a representative from this country to the conference of European maritime countries to be held in the autumn? In reply, Sir Charles Dilke said Her Majesty's Government accepted an invitation from the French Government to take part in a conference on this subject, which was to have met at Paris on the 1st of last month. The French Government, however, postponed its meeting until the autumn. Her Majesty's Government are of opinion that advantage might be taken of this delay to settle beforehand the scope of the labours of the conference. They are at present in communication with the French and other Governments concerned, and if an understanding is arrived at on this point they will be represented at the conference.

UNDERGROUND CABLES IN GERMANY.—A commencement has been made in Strasburg with the laying of the underground cables intended to replace the overhead wires, which start from the Telegraph Office of the Quai de Paris, some in the direction of the covered bridges and others in a parallel direction to the Faubourg de Saverne. The cables are laid in a trench, about one metre deep (3·28 ft.), which from the building of the central telegraph office, passes over the Bridge de Saverne, under the footpath on the right, and then along the right side of the Faubourg de Saverne, as far as the embankment of the new railway station. In this trench four cables will be laid, each composed of seven telegraph wires for the lines to Paris, Weisenburg, Lauterburg, &c. A second trench starting as well from the Quai de Paris and following the left side of the Quai de Saverne, will be dug along the Quai Saint Jean, through the large street de la Course, as far as the central railway station, and in this trench six cables will be laid, each composed of seven telegraph wires, and intended for the traffic over the lines to Basle, Kehl, Molsheim, &c. One of the cables will be laid in the Küss street, in order to establish a direct communication between the central railway station and the telegraph office of the Quai de Paris. The cables then follow the different lines which start from the new central railway station, and are continued till outside the new fortifications, when the telegraph wires become again overhead wires.—*La Lumière Electrique.*

THE BONE-BISERTE CABLE.—The French Government telegraph steamer *Charente* started laying this cable from Bone, on the 21st ult., and we read in the *Petit Marseillais*, of the 28th ult., the following:—"The laying of the submarine telegraph cable between Bone and Biserte has been successfully completed last night. The cable between La Calle and Biserte will be worked as before, to relieve the traffic. Another Director of Posts and Telegraphs, M. Cayler, is expected, to replace M. Rubichon, who is allowed to retire on a pension. It has been found necessary to re-arrange the Tunisian telegraph staff owing to the great devolopment of that service with Tunis."

MEXICAN CABLES EXTENSION.—The ss. *G. E. Wood*, chartered by the India-rubber, Gutta-percha, and Telegraph Works Company for the Mexican Cables Extension safely returned from Mexico on Monday the 3rd inst. She is now discharging, off the Silvertown Works, the cable stores, machinery, tanks, &c., with which she was fitted for that expedition.

THE CABLE SHIP "CAROLINE."—The ss. *Caroline*, chartered for the repairs of the Otranto-Corfu cable, left Messrs. W. T. Henley & Co.'s Works on the 28th ult. We understood that Mr. W. A. Killingbeck went out in charge of the cable staff, but this is not confirmed.

SUBMARINE TELEGRAPHY.—We extract the following from the *Times*, concerning Mr. Jacob Brett and the invention of submarine cables. A correspondent writes:—

Mr. John Watkins Brett and his brother, Mr. Jacob Brett, may unquestionably be designated as the original projectors (if not inventors) of the Submarine Telegraph, for as far back as July, 1845, the Messrs. Brett registered their plan for an oceanic or submarine telegraph, and in the same year took out patents for the construction of subterranean lines. In 1847 they obtained permission from the Government of Louis Philippe to establish a submarine cable between the coasts of France and England, but were unable to obtain any support from the public to carry out the undertaking. In 1849 a concession for the same object was granted to them by Prince Louis Napoleon, then President of the French Republic, and in 1851 the Submarine Telegraph Company was formed, and a substantial cable containing four conducting wires, and protected by a coating of strong iron wires, was laid between Dover and Sangatte, near Calais, and this cable is at the present moment in excellent working condition. Mr. John Watkins Brett became afterwards one of the founders of the Atlantic Telegraph, and also of various telegraph lines in the Mediterranean. He died in 1863, leaving only a moderate fortune to be divided among a numerous family of brothers and sisters. Since that time Mr. Jacob Brett, who is now seventy-four years of age, has fallen into most serious pecuniary difficulties, and at the present moment is absolutely without a home or any means of supporting himself. A committee, consisting of Sir James Carmichael, Chairman of the Submarine Telegraph Company, and other gentlemen interested in telegraphic enterprise, has therefore been constituted to promote the subscription of a fund in aid of Mr. Jacob Brett, to which the Submarine Company have given £200, and an appeal is confidently made on his behalf for further assistance to those companies and individuals, as well as to the public in general, who have derived such great benefits from the establishment of the Submarine Telegraph. It must be remembered that if the earlier experiments of Messrs. Brett had ended in failure, the world might have been long deprived of that invention which Lord Granville has so happily termed "the wonderful instrument of communication of thought."

Sir J. R. Carmichael writes from 2, Throgmorton Avenue, London, E.C., July 1st:—

With reference to a communication respecting "Submarine Telegraphy," which is published in the *Times* of to-day, may I be permitted to add that Messrs. Ransom, Bouverie, and Co., of 1, Pall Mall East, have kindly consented to receive any subscription to the "Benefit Fund" in aid of Mr. Jacob Brett, which is alluded to by your correspondent.

TELEGRAPHS IN CHILI.—The *Chilian Times*, of May 13, says:—

The improvement and extension of the State telegraph system is under the consideration of the Government. In a report of the 2nd inst. the Director-General of Telegraphs recommends the establishment of offices at Pena Blanca, Paiguano, Tongoy, Panulcillo, Palmilla, Matanzas, San Antonio de las Bodegas, Llico, Vichuguen, Curepto, Florida, Curanipe, and Castro, the last-mentioned place being on Chiloe Island. The estimated cost of the extensions is a little over 74,000 dollars. The director also points out the necessity of laying an additional wire from Iquique to Canete, the present line being totally inadequate to meet the requirements of the public. If the proposed extensions should be carried out, and we presume they will be, the total length of the State telegraph lines will be 14,265 kilometres.

LAUNCH.—On the afternoon of Thursday, the 29th ult., Messrs. John Elder and Co. launched, from their Fairfield Works, Glasgow, the steel paddle-ship *Normandy*, constructed by them for the London, Brighton, and South Coast Railway Company, and the Western of France Railway Company. The *Normandy* is similar to, though somewhat larger than, the *Victoria* and the *Brighton*, owned by these companies. She will be very handsomely fitted for 100 first-class and seventy second-class passengers, and every convenience necessary for the channel passage, including electric bells and the electric light, will be provided.

MAGNETIC OBSERVATIONS AT THE PARIS OBSERVATORY.—We are glad to learn that owing to the exertions of Admiral Mouchez magnetical observations will soon be resumed at the Paris Observatory in subterranean chambers, which have been excavated in the newly annexed ground. These observations will be self-registering by photography, in conformity with the instruments established by M. Mascart at the Collége de France. Direct observations will also be taken with the old instruments, which were used by Arago, who was famous for his prognostications of auroræ at a period when, the electric telegraph not having been invented, many days must elapse before the arrival in Paris of news from the northern parts of Europe.

ON THE CHEMICAL WORK PRODUCED BY THE BATTERY.—By M. D. Tommasi.—Joule and Favre have shown that the power of the galvanic battery has a close relation with the heat which the chemical reactions in the battery itself produce. An entire order of questions respecting currents may be treated as calorimetric problems. The electromotive force of a battery is proportional to the heat evolved by chemical action, and thus if we know the number of calories dis-

engaged by such action we may arrive at the work which the battery is capable of performing. Favre, however, has pointed out that the heat brought into play during the combustion of the hydrogen in electrolysis is transmitted or not transmitted to the circuit according to the nature of the compound which furnishes the oxygen necessary for such combustion.

Thus, *e.g.*, of 131 cal. evolved by an element with oxygenated water and hydrochloric acid, there are merely 41·6 cal. which are transmitted to the circuit, and which consequently represent the energy of the battery. Favre observed, further, that in the sulphatation of the zinc of a simple element (zinc, platinum, and acidulated water), 39 cal. are brought into action; but of this number 29·8 cal. only are transmitted to the circuit, whilst 9 cal. remain in the interior of the battery.

I will first examine this latter case, as being the most simple, and will treat afterwards of the calories evolved in elements with two liquids.

1st. A zinc-platinum element with dilute sulphuric acid (Smee's battery) evolves, according to Favre, 39 cal.; but of this number there are only 29·8 cal. transmitted to the circuit, and representing the energy of the battery. It would then follow that two such elements could not decompose water. In fact,

$$29{\cdot}8 \text{ cal.} + 29{\cdot}8 \text{ cal.} < 69 \text{ cal.}$$

But I have shown that the decomposition of water takes place conformably with what might have been expected if all the calories disengaged by the two elements had been transmitted to the circuit. Thus,

39 cal. + 39 cal. > 69 cal. (Favre), or 38 cal. + 38 cal. + 1 cal. > 69 cal. (calculated from the most recent thermic data).

If the water of the voltameter is acidulated with hydrochloric acid the decomposition of the water is facilitated, as might be foreseen, knowing that the electrolysis of dilute hydrochloric acid absorbs per two molecules merely 66 cal., in place of 69. But even in this case there should be, according to Favre, no electrolysis, since 29·8 cal. + 29·8 cal. < 66 cal.

If, in the preceding elements, we substitute for the two platinums two plates of graphite previously heated to redness, which ought not, according to received ideas, to modify the chemical action of the battery, the decomposition becomes very brisk. But if we use electrodes of coke with a large surface the decomposition of the water is, beyond comparison, more energetic.

2. According to Favre, two zinc-platinum elements with dilute hydrochloric acid ought not to decompose water if acidulated with sulphuric acid, but should decompose it if acidulated with hydrochloric acid. In the former case we should have—

$$33{\cdot}4 \text{ cal.} + 33{\cdot}4 \text{ cal.} > 69 \text{ cal.; but in the second—}$$

33·4 cal. + 33·4 cal. < 69 cal. In fact, two such couples do not decompose water if acidulated with sulphuric acid, but the decomposition ensues if the water is rendered acid with hydrochloric acid. Two zinc-graphite elements, or preferably two zinc-coke elements, decompose briskly water acidulated with sulphuric acid. It is the same if we use a zinc-carbon element along with a zinc-platinum, though in this latter case the action is more feeble. In either case the decomposition cannot be explained according to Favre, but it is intelligible on thermic principles. 34·2 cal. + 34·2 cal. + 1 cal. > 69 cal.

3. A zinc-platinum element in dilute hydrobromic acid ought to develop according to Favre, 35·9 cal., of which only 29·9 are transmissible to the circuit. Consequently two such elements ought not to decompose water acidulated either with sulphuric or hydrochloric acid; if the water of the voltameter is acidulated with sulphuric acid, we observe a beginning of decomposition, which soon comes to an end. The decomposition of water is more marked with a zinc-graphite and a zinc-platinum element, and better still with two zinc-graphites. It is most energetic with two zinc-coke elements. If the water of the voltameter is acidulated with hydrobromic acid there is also electrolysis; but it is not the water which is decomposed, but the hydrobromic acid itself. Whatever the degree of dilution of this acid, we always see an escape of gas at the negative electrode; whilst at the positive electrode there is no escape of gas, but a yellowish thread of bromine is formed round the platinum wire. This fact is easily explained, since 2 molecules of hydrobromic acid absorb 59 cal. for their decomposition, whilst 1 molecule water absorbs 69 cal.; so it is always the compound which absorbs least heat, which is decomposed in preference by the current, as the author showed in 1879.—*Comptes Rendus.*

ON THE INFLUENCE OF THE POSITIVE ELECTRODE OF THE BATTERY UPON ITS CHEMICAL WORK.—By M. D. Tommasi.—In my researches upon electrolysis I have ascertained the singular fact that the electromotive force of one and the same couple may vary according as the positive electrode is of platinum or of coke. An element, *e.g.*, which is incapable of effecting the electrolysis of water or a saline solution, although the calories which it disengages are greater than the calories absorbed by the decomposition of the electrolyte, if its positive electrode is of platinum, becomes able to produce such a decomposition if its positive electrode is of coke. As this fact is of great importance as regards the relation which I am seeking to establish between the calories liberated by the battery and the calories absorbed by the decomposition of the electrolyte, I have examined it in some detail, and have made the following observations:—

A magnesium platinum couple in dilute sulphuric acid ought, according to thermic data, to decompose water; the number of calories liberated by the action of magnesium upon dilute sulphuric acid (112) is greater than the number of calories of the decomposition of water (69). Nevertheless, the decomposition does not take place. It is the same if we substitute copper or silver for the platinum of the element, but if we use as a positive electrode a cylinder of graphite or of coke, the electrolysis of the water takes place.

According to M. Berthelot, two zinc-platinum elements with dilute sulphuric acid do not decompose a solution of sulphate of potash. But on employing two zinc-carbon elements with dilute sulphuric acid, I have been able to electrolyse a saturated solution of sulphate of potash with a copious liberation of gas at the two platinum electrodes, and a transfer of the acid to the positive electrode and of the base to the negative electrode, and this in the lapse of a few minutes and at the common temperature. There are required, according to M. Berthelot, at least 103 cal. to electrolyse a solution of sulphate of potash, whilst I obtain this same decomposition with 76 cal. and even fewer, for it is produced with two zinc-carbon elements and dilute hydrochloric acid, say with 69·8 cal. (calories disengaged by the action of a molecule of amalgamated zinc upon dilute hydrochloric acid). A single zinc-coke element with dilute sulphuric acid decomposes sulphate of potash if the electrode of the voltameter is of copper, but not if the electrode is of silver.

I have submitted various salts to electrolysis. The conditions of the experiments are as follows:—The saline solutions contained an excess of salt. The platinum wires of the voltameter were 0·4 mm. in diameter, and plunged into the liquid to a depth of 0·3 to 0·4 metre. The carbons employed were Siberian graphite or gas-coke previously heated to redness and cooled in a stoppered bottle containing air, nitrogen, and by preference, carbonic acid. To obtain good results, the coke or the graphite should remain at least six hours in contact with carbonic acid. The presence of this gas in the pores of the coke has no other object than to retard the polarisation, rendering consequently the effects more intense and giving them a longer duration. Two zinc-carbon elements with dilute sulphuric acid (= 77·4 cal.) decompose the following saline solutions:—Sulphates of magnesia, zinc, cadmium, copper, manganese, iron, chloride, bromide, and iodide of potassium.—*Comptes Rendus.*

OBSERVATIONS ON ELECTRIC FISHES.—By Herr G. Fritsch.—The author during a sojourn in Egypt has made a series of anatomical and physiological observations on *Malopterurus electricus*. He has also confirmed the suggestion of Babuchin that *Mormyrus* also is an electrical fish. From a very lively specimen of *Mormyrus oxyrhinchus*, 165 millimetres in length, he obtained in two and a half hours twelve electric discharges. This small fish did not

live long, and the author did not possess the apparatus necessary for determining the direction of the discharge. As, however, the genus *Mormyrus* is rich in species, now their electric properties are recognised it will not be difficult to study them more closely.—*Du Bois Reymond's Archiv.*

On the Dispersive Power of Electricity.—By L. Palmieri.—If the bifilar electrometer of Palmieri receives either a positive or a negative charge the losses of electricity in a space protected from currents of air are in equal times rather greater for a negative charge than for a positive. The differences are greater in dry weather, and disappear in very moist air.—*Wiedemann's Beiblätter.*

Means of Rendering the Holtz Machine more Active.—By C. Marangoni.—The discs are freed from varnish, steeped in distilled water for twenty-four hours, set to dry in a vertical position without touching anything, and re-introduced into machine. It acts then again for some time in a protective case. The discs, therefore, are not to be varnished. The machines are excited by a gutta-percha plate better than by ebonite.—*Wiedemann's Beiblätter.*

The Electric Tensions between a Metal and Liquids of Different Concentration.—By Erasmus Kittler.—The author has made a long series of determinations of the differences of tension of certain chlorides in various combinations. The results are here given, our readers being referred to the original for the details of the observations.

If in the combination : copper | solution + solution | copper sulphate + copper sulphate | copper, there are substituted successively the concentrated aqueous solution of chlorides of potassium, sodium, ammonium, lithium, calcium, strontium, barium, magnesium, manganese, and nickel, there are obtained on using a dilute solution of sulphate of copper (0·6 parts to 100 of water) the following electromotive forces: chloride of ammonium = 0·318 Daniell; chloride of potassium = 0·315 D.; chloride of lithium = 0·308 D.; chloride of calcium = 0·304 D.; chloride of sodium = 0·302 D.; chloride of strontium = 0·290 D.; chloride of magnesium = 0·275 D.; chloride of barium = 0·251 D.; chloride of manganese = 0·247 D.; chloride of nickel = 0·231 D. The series in which these chlorides fall remains the same if distilled water is used instead of solution of sulphate of copper.

If dilutions of these chlorides are used instead of saturated solutions the electromotive force of the elements decreases with the proportion of the salt in the solution, whether in presence of sulphate of copper or of distilled water. The influence of the concentration of the chlorides upon the electromotive force is very considerable. The difference is greatest with chloride of ammonium, and smallest with chloride of sodium.

The arrangement : copper | $L_1 + L_1$ | $L_2 + L_2$ | copper, in which L_1 and L_2 represent saline solutions of different degrees of concentration, give a current in the direction from L_1 to L_2. The current consequently passes from the chloride to the sulphate of copper, or to water, and from the more concentrated to the more dilute solution.

Volta's law of tension holds good for solutions of the above chlorides of different strengths in contact with distilled water, and a solution of sulphate of copper.

The combination : copper | solution + solution | sulphuric acid + sulphuric acid | copper, yields for the saturated solutions of the chlorides above mentioned a different series than the above combination with sulphate of copper. Here chloride of calcium gives the greatest electromotive force = 0·335 D.; then follows chloride of strontium = 0·334 D.; chloride of lithium = 0·323 D.; chloride of magnesium = 0·321 D.; chloride of manganese = 0·294 D.; chloride of ammonium = 0·283 D.; chloride of sodium = 0·287 D.; chloride of nickel = 0·265 D.; chloride of barium = 0·254 D.

Here also the electromotive force decreases with the proportion of salt in the solution, but the influence of the degree of concentration is here more prominent than in the former combinations. The current passes in this combination from the chloride to the acid, but if very dilute solutions are used, from the acid to the chloride or to water; the v of tension does not hold good for the chlorides in contact with dilute sulphuric acid. The electromotive force of the liquid combination : sulphate of copper | solution + solution | sulphuric acid + sulphuric acid | sulphate of copper, in which the members, sulphate of copper and sulphuric acid, remain constant, changes considerably with the proportion of saline matter in the solution—*Naturforscher & Annalen der Physik.*

On the Law according to which the Electromotive Force of a Magneto-electric Machine varies as a Function of the Resistance of the Exterior Circuit. —By M. Marcel Deprez.—The author, in his experiments on dynamo-electric machines, has been struck with the fact that the electromotive force developed in the ring of these machines not merely does not increase infinitely with the intensity of the current which traverses the inducing electro-magnets, but even decreases very notably, whilst the current produced increases more and more.

He has thus been led to think that the electromotive force developed in the ring of a magneto-electric machine, whose magnetic field is constituted by a permanent magnet, is not constant, as has been hitherto admitted, but is a function of the intensity of the current developed in the ring.

To verify this supposition, he has kept the magnetic field of a Gramme machine constant by exciting the inducers by means of an auxiliary source, and has examined how the electromotive force of the ring, turning at the same velocity, varies on closing the outer circuit with more and more feeble resistances. The experiments, given at length in the original memoir, show that the electromotive force developed on the ring decreases when the intensity of the current produced augments. They show also distinctly that the constant fall in the "characteristics," when the current produced becomes very intense, depends on the insufficiency of the inducers. These are, indeed, never too powerful, which is an additional argument in favour of large machines, as the author has demonstrated both theoretically and experimentally that a magnetic field of given intensity is the less expensive to obtain, as it is produced by electro-magnets of more considerable dimensions.

As for the cause of this phenomenon it may be explained as follows : suppose that the passage of the current is suppressed in the inducers and only let pass in the ring, the latter becomes a powerful magnet, the polar lines of which coincide with the diameter, which passes through the points of contact of the brushes and the collector.

If we invert the operation by suppressing the current which traverses the ring, and re-establishing that in the inducers, the polar line coincides with that of the inducers. Hence it results that when the current traverses at once the ring and the inducers, the line of the poles of the ring occupies a position intermediate between the two extreme positions just defined, and may even be determined by that of a construction analogous to that of the parallelogram of forces. It is easy to see, on applying this construction, that the polar line of the ring approaches so much the more to the line of contact of the brushes as the current traversing the ring is more intense, whilst the maximum difference of the potential between the two brushes corresponds, on the contrary, to the case where the polar line of the ring is perpendicular to the diameter, passing through the points of contact.

This amounts to saying that, in proportion as the intensity of the current traversing the magnetic ring increases, the wires of the ring intersect the lines of force of the magnetic field, comprised between the polar pieces and the ring at an angle which differs more and more from a right angle, which is, as is known, the angle corresponding to the maximum electromotive force.

The sole means of reducing within certain limits the defect inherent in all dynamo-electric machines consists in the use—

1st. Of very powerful inducers, surrounded with a moderate quantity of wire.

2nd. Of brushes of variable level.—*Comptes Rendus.*

Electric Fire Signal.—By M. Carré.—This apparatus consists essentially of an iron wire stretched by a spring which acts constantly, and when the wire is elongated in

consequence of a given rise of temperature, it closes an electric circuit in which there is an alarm-bell. The communication is established instantaneously by the rupture as well as by the expansion of the wire.—*Comptes Rendus.*

REMARKS ON THE USE OF ZINC-COKE ELEMENTS IN ELECTROLYSIS.—By R. Berthelot.—A zinc-coke element cannot be regarded as equivalent to a zinc-platinum element in calculating the quantities of heat set free by the reactions which give rise to the galvanic current. The heat disengaged by the attack of the zinc and the acid is not, in the case of coke, the only heat. The coke exerts in these conditions peculiar and complicated reactions. It absorbs hydrogen and oxygen, and intervenes both by the pure carbon which it contains and by the foreign matters mixed in its mass. This is shown by the researches of M. E. Becquerel ("Annales de Chimie et de Physique," 3rd Série, t. xlviii., p. 256) on the electro-motor of such elements. The author adds that the thermic values which express electrolytic reactions are only established for dilute liquids; the effects due to the separation of a trace of acid and of base in saturated saline solutions cannot be exactly calculated by reason of the changes of concentration and the secondary reactions. The principles of the calculation are the same, but the data are wanting.—*Comptes Rendus.*

OSCILLATIONS OF THE PLANE OF POLARISATION BY THE DISCHARGE OF A LEYDEN BATTERY. SIMULTANEITY OF THE ELECTRICAL AND OPTICAL PHENOMENA.—By MM. E. Bichat and R. Blondlot.—We have undertaken to study the rotation of the plane of polarisation in a transparent body under the action of the current of the discharge of a Leyden jar. The experiment was arranged in the following manner: between a polariser and an extinction analyser was placed the transparent body in a coil of long and thin wire, connected with the coatings of a battery. In the circuit was introduced a universal discharger, which permitted the discharge to be produced when the difference of potential is sufficient. At the moment of each discharge the eye placed before the analyser perceives a bright reappearance of light, which shows that the plane of polarisation has deviated.—*Comptes Rendus.*

REMARKS ON THE PRODUCTION OF LICHTENBERG'S FIGURES.—By K. L. Bauer.—For several years the author has in his physical class produced the Lichtenberg figures by dusting a smooth even plate of hard rubber (an electrophorus plate) with lycopodium, and then allowing a stream of sparks to pass upon the plate from the knob of a Kleist jar, charged either positively or negatively. This procedure, in which the two customary operations are performed in an inverted succession, may be recommended because, according to the author's experience, it gives fine, well-characterised figures with more certainty than that generally prescribed. Jars of different sizes may be used, on the rods of which conductive buttons of different size, shape, and material may be screwed or fixed. The conductive connection of the knob with the internal coating must remain when the jar is inverted, for the purpose of discharging, so that the rod with its knob is directed perpendicularly downwards. Hence the connection cannot be effected by means of metal chains. —*Annalen der Physik und Chemie.*

ON COLOURED SPARKS AND THEIR PRODUCTION BY INTERNAL AND EXTERNAL RESISTANCES.—By W. Holtz.—In Vol. iii., p. 626, of the *Beiblätter*, 1879, there appears a notice on the production of coloured sparks which are obtained by interposing semi-conductors between Leyden jars, or using semi-conductors as coatings for the jars themselves. I cannot refrain from pointing out that as far back as 1875 (*Pogg. Annalen*, Ergänzungsband vii., p. 520, 1875) I described at length the production of coloured sparks by external resistance. In 1877 (*Pogg. Annalen*, 160, p. 559, 1877) I showed that the same effect may be obtained by means of internal resistance. I did not remain satisfied with coating the jars with semi-conductors, but I filled the jars with imperfectly conductive liquids instead of an internal coating. Though I have latterly not recommended internal resistances for the above purpose, it is because external resistances are equally efficient and more convenient.—*Annalen der Physik und Chemie.*

NEW COMPANY REGISTERED.

PYRAMID ELECTRIC COMPANY (LIMITED).—Capital: £80,000, in £1 shares. Objects: To purchase for £6,000 in cash and £16,000 in fully paid deferred shares the electric inventions of William B. Brain and Radcliffe Ward, and the business carried on by the former under the style of the Electric Blasting Apparatus Company in the Forest of Dean, Gloucestershire. Signatories (who take one share): W. B. Brain, Cinderford; R. Ward (electrical engineer), 7, Northumberland Street, Strand; A. L. Foster, East Hill, Wandsworth; T. S. Collins, Ross, Hereford; R. Ferguson, 7, Oxford Terrace, W.; B. Le Neve Foster, East Hill, Wandsworth; C. W. Parkes, 11, Queen Victoria Street. Directing qualification: £300 of nominal capital. Remuneration: £21 for each meeting, to be divided as the directors may determine. Registered 29th ult. by Charles Doubble, 14, Serjeant's Inn, Fleet Street.

NEW PATENTS—1882.

3039. "Galvanic batteries." C. P. NEZERAUX. Dated June 28. (*Complete.*)

3042. "Incandescent electric lamps." F. L. WILLARD. Dated June 28.

3046. "An improved method of abstracting gold and silver from their ores, by the combined action of electricity and mercury." R. BARKER. Dated June 28.

3047. "Telephone receivers." W. SPENCE. (Communicated by M. Kotyra.) Dated June 28.

3048. "Insulating and protecting telegraph wires and other electrical conductors." G. MACAULAY-CRUIKSHANK. (Communicated by W. C. Banta.) Dated June 28.

3054. "Means or apparatus for regulating the production of electricity." J. C. MEWBURN. (Communicated by F. Rigaud.) Dated June 28.

3061. "Magnetic compasses." F. BETBEDER. (Communicated by E. Bourse.) Dated June 28.

3070. "Electric arc lamps." E. DE PASS. (Communicated by C. Roosevelt and B. Adbank *alias* Abakanowicz). Dated June 29.

3073. "Improvements in electric railways or tramways, and in means or appliances to be used in connection therewith, parts of which improvements are applicable to the propelling of vehicles on common roads by electromotive force." H. BINKS. Dated June 29.

3079. "Electric lamps." J. H. JOHNSON. (Communicated by L. BARDON.) Dated June 30.

3097. "Secondary batteries." A. WATT. Dated June 30.

3099. "Preparation of carbon filaments." A. R. LEASK and F. P. SMITH. Dated June 30.

3101. "An improved arc electric lamp." R. H. COURTENAY. Dated June 30.

3107. "Secondary batteries." C. H. CATHCART. Dated July 1.

3108. "Improvements in secondary batteries or magazines of electricity, and in apparatus connected therewith." H. J. HADDAN. (Communicated by C. F. Brush.) Dated July 1.

3115. "Generators." L. P. MARTIN. Dated July 1.

3120. "Galvanic batteries." J. H. DAVIES. Dated July 1.

3128. "Electric logs, or apparatus for ascertaining the speed of ships and the rate of currents." R. M. LOWNE. Dated July 3.

3129. "Machines for generating electricity." T. VARLEY and H. B. GREENWOOD. Dated July 3.

3142. "Manufacture of submarine telegraph cables." G. E. VAUGHAN. (Communicated by S. Trott and F. A. Hamilton.) Dated July 4.

3150. "Dynamo or magneto-electric machines, which also serve as electro-motors." R. WERDERMANN. Dated July 4.

3160. "An improved method of, and means for, regulating the currents in dynamo-electric machines." W. R. LAKE. (Communicated by J. Carpentier.) Dated July 4.

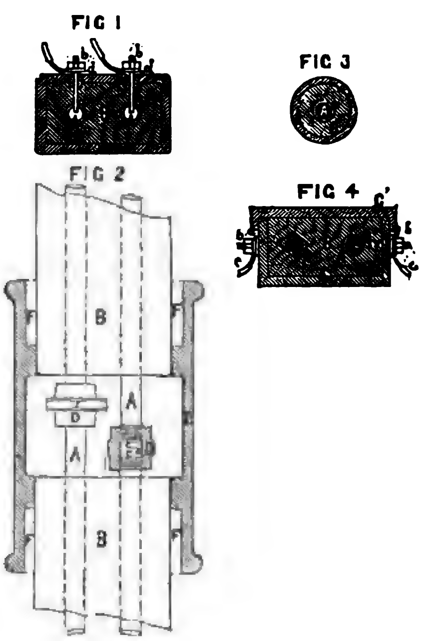
3161. "Incandescent lamps." A. R. LEASK. Dated July 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

5050. "Apparatus for automatically transmitting and receiving signals, &c." F. R. FRANCIS. Dated November 18. 6d. Relates to improvements in apparatus for automatically transmitting and receiving signals, for denoting places at which attempted burglar

and robberies may be made, and for other purposes, consists in the application, combination, and arrangement of a series of specially constructed commutators or contact makers, in number corresponding with the signals required, or with the rooms, doors, windows, safes, and other parts of buildings or things to which the commutators may be affixed in connection with insulated copper and galvanised iron, or other wires, for communication between buildings or things so fitted as aforesaid, and the nearest police or other stations, and arranged so that each commutator or contact maker is capable of producing one signal only, such signal being the name and number of the building, house, room, door, window, safe, or other thing so fitted, as before mentioned, with the commutators or contact makers, thus showing the precise locality of any attempted burglary or robbery.

5080. "Apparatus for the conduction and distribution of electric currents." R. E. B. CROMPTON. Dated November 21. 6d. The inventor constructs durable and economical insulated conductors, specially suitable among other things for use in electric lighting on a large scale in the following manner:—Copper rods are taken of proper thickness and their ends are enlarged by a suitable tool, and on these enlarged ends screw threads are cut. The ends are thus enlarged to preserve the effective section of the conductor from being reduced at the joint. The pitch of these screw threads is so taken that at each junction, when the rods are placed in the order in which they are to lie in forming the conductor, the screw threads on the two adjacent ends are of slightly different pitch. Over these ends is screwed a sleeve or socket. When this is screwed up in the proper direction it forces the ends of the conductors into very intimate contact. The screw threads on the extreme ends of the rods are stripped for a little distance to allow of the rods being so screwed together, or some other equivalent method is used. The conductors so formed are insulated by placing one or more of them in tubes of convenient section. These tubes will in general be made of cast iron for the sake of cheapness. The conductors may be, if desired, maintained in the proper position within the tubes during the process of insulation by core nails or chaplets, such as are used for the support of the cores of pipes when cast horizontally; the tubes are then placed containing the copper rods in a vertical position, and purified blast furnace slag is poured in so as to form a vitreous insulating envelope, thoroughly insulating and protecting



each of the conductors. To insure perfect and intimate contact between the conductors and their insulating envelope, it is preferred to enamel them before placing them in the tubes. After the process of running in the vitreous matter is complete, and it has become hard, the chaplets or core nails are removed. The holes left by them can be filled up with insulating material of any durable kind, and the hole in the tube closed by a screw plug if there is no desire to join a branch on to the main at that point. If however it is intended to bring out a branch from the main at that point, a copper plug of proper length is screwed into the metal of the conductor, and brought out through a porcelain or glass washer, or surround it with other suitable insulating material, so as to prevent it coming into electrical contact with the metal tubes or any other conductor in the tubes or the earth. The branch wires are connected to these copper studs preferably by baring a portion of the branch wire, and after stripping it of any insulating material that may be on it, taking a turn with it under the head of the copper plug before it is screwed down. The hole through which the branch connection is made may with advantage be covered by a cast iron hood or cap screwed down to the outer surface of the envelope, and finally filled with pitch, or gutta percha, or other suitable insulator to prevent the entrance of moisture. The insulating material should if possible be poured in in a fluid state through a hole in the cap, which should finally be secured by a screw plug. The tubes or cases above described in which the conductors are placed are joined by means of short tubes made to slip over and fit somewhat closely upon the adjacent ends of those containing the conductors, and these short tubes are joined to those over which they slip by ordinary gasket and run lead joints, such as are used in the case of cast iron water pipes, or it may be found convenient to use rubber packing, or rubber rings, or other well known modes of making such joints water tight, and at the same time not perfectly rigid, to allow for the movements caused by expansion, settlement of the ground, or other like causes. In the walls of these socket pipes holes are to be left, through which melted pitch or other suitable insulating material can be poured, so as to fill them up entirely after the joints above referred to have been securely made, and the holes are finally filled up with screw plugs. To enable these socket pipes to be used the conductors are made to project such a distance beyond the tubes that contain them as to enable the junctions to be most easily constructed. Fig. 1 shows a transverse section of a tube of cast iron or other suitable material containing two conductors, A, A, of copper enamelled, and these conductors, A, A, are imbedded in and insulated from each other and from the containing tube or case by means of the mass of slag or other suitable vitreous material, B, which fills the remaining space in such case. Where it is desired to bring out branches from the conductors, A, A, there are screwed into the conductors, A, A, copper plugs, *a*, *a*, passing such plugs through porcelain, glass, or other insulating washers, *d*, *d*, which are screwed or otherwise secured into the case, C, and to these plugs, *a*, *a*, are attached suitable connecting wires or leads, by means of the nuts, *b*, *b*, or other suitable connections. Fig. 2 shows by a longitudinal plan view, partly in section, an arrangement of parts adapted for connections of portions of tubes and their contained conductors, A, A. The end portions, e^1, e^2, of the conductors, A, A, are somewhat enlarged, and are formed with screw threads thereon, adjoining ends being as shown alternately formed with threads of finer pitch, e^2, and coarser pitch, e^1, and over these are passed and screwed correspondingly threaded socket pieces, D, D, which thereby hold these parts together. The conductors thence pass into and are embedded in the masses of slag, B, B, partly within the sleeve piece, E, and thence to within the tubes or cases, which are passed to within the spaces, F, of the piece, E, which serves to connect those part tubes. Fig. 3 shows a section of a single core or conductor, A, with its enamel covering, *e*, its insulating coating of slag, B, and containing metal tube, C, which tube may be conveniently formed of wrought iron. This arrangement will be found particularly convenient when two conductors are not required. Fig. 4 shows a section of another arrangement of parts somewhat similar to that shown by fig. 1, but more particularly adapted for being placed in the footways of roads. The like letters of reference indicate like parts, as in fig. 1, and the description thereof applies equally well to this arrangement, except that in this arrangement of tube or case, C, one side (the upper side as shown) is adapted for removal in the form of a lid, C^1, affording means of easy access to the rods or conductors and their insulating covering and the branch connections, and these branches, *b*, are applied from the side of the case, *c*. The covers, C^1, may be roughened or formed so as to afford good foothold.

5096. "Electrical commutators." W. R. LAKE. (A communication from abroad by Francis Blake, of America). Dated November 22. 6d. Consists in combining with a pile of plates of metal and hard india-rubber or other insulating material put together alternately, a number of smaller metallic plates, one for each of the electric circuits between which connections are to be made, the smaller plates secured to one of the large insulating plates, and a peg-hole in and through each small plate extending also through all the large plates.

5140. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated November 24. 6d. Has for its object improvements in telephonic and telegraphic signalling apparatus. The improvements are applicable mainly where a series of stations are connected by a line wire, and where it is desired that any station may when the line is unoccupied, be able to place itself in communication with any other station on the line, excluding other stations, so that they can neither hear nor interrupt. At each station an instrument is provided with a graduated series of resistances which the operator can insert in the line circuit to vary its resistance. Each instrument is provided with an electro-magnet with armatures held back by springs differently adjusted, or other like contrivance for appreciating the resistance in the line circuit (the battery remaining constant). This appreciating contrivance controls the connections both of the resistances and of the receiver and transmitter, preventing their being placed in effective connection with the line circuit, except the resistance of the line circuit has been set to a pre-arranged quantity. Each instrument is provided with blocking parts, which render the variation of the resistance inoperative in the instrument in which it is produced. This combination works together in the following manner:—An operator wishing to call another station moves a handle to a corresponding mark, and thereby he first blocks and renders inoperative the appreciating contrivance of his own instrument, and then adjusts the resistance of the line circuit. The appreciating contrivances at all the other stations respond, preventing effected connection being established with the line at all stations but the one having an instrument adjusted to the particular resistance which has been brought about. The bell at this station being rung, the operator there moves his handle, thereby blocking his instrument also, and establishing the communication. On the handles being replaced the line is ready for other stations similarly to converse. When an induction coil is made use of in connection with telephonic apparatus, a secondary coil is divided into sections and made use of as resistance to be added to the line circuit to effect the desired adjustment. The coils of the telephone can be similarly employed.

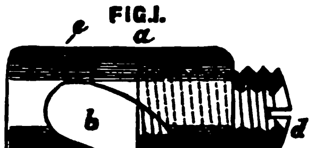
5159. "Galvanic batteries, &c." R. E. B. CROMPTON and D. G. FITZ-GERALD. Dated November 25. 4d. Relates to the construction of the electrodes of galvanic batteries, especially of the type known as secondary batteries or electro chemical accumulators. In these batteries it is desirable to increase as much as possible the surface of the electrodes, and

sometimes to give to them a structure which permits of large quantities of gas being occluded or retained at or near the surfaces. This is accomplished by giving to the electrodes a highly porous structure, and otherwise extending their surface in the following manner:—The electrode is made of a mixture of lead and some other substance capable of being extracted and removed therefrom by the action of water, acids, or other chemical re-agents, or by heat, or by electrolysis. When the mixture has been made into a shape suitable for the electrode the foreign substance is removed, wholly or partially, by some of the means herein before referred to, and the lead of the electrode is left with a porous structure, which greatly increases the surface exposed to the electrolyte, when it is made to form part of a secondary battery.

5198. "Secondary batteries for the production, &c., of electric currents." C. H. W. BIGGS and W. W. BEAUMONT. Dated November 28. 6d. In the usual form of secondary electric batteries, the products of electric decomposition appearing at the poles of the charging battery or dynamo or magneto-electric machine are collected and retained in the charged battery itself. Now according to this invention, the inventors prevent loss of these products, and regulate the recombination of these products in a better manner by collecting and retaining the same in two connected holders, and recombining them in the quantities required in order to produce electric currents.

5226. "Joining branch to main conducting wires for electrical purposes," &c. A. W. BREWTNALL. Dated November 29. 6d. Relates to improved means of coupling branch wires to main conducting wires or cables, as required in the installation of electric lamps for example, whereby the connection of the wires may be made, and the insulation of the coupling effected with great ease and rapidity. The coupling consists of a screw stud perforated with a longitudinal hole, through which the end of the branch wire to be connected is passed freely, and having a cross groove in its head at one side, intersecting the longitudinal hole, and forming a hook-shaped jaw fitting upon the main conducting wire or cable (bared of its insulating covering) which lies therein, and is tightly gripped between the jaw and a nut screwing upon the threaded stem of the coupling. The nut presses the main wire or cable forcibly into the jaw and against the branch wire at the intersection of the jaw with the longitudinal perforation, the act of screwing up the nut thus

FIG.1.



binding the branch wire tightly in the coupling and clamping the latter firmly upon the main wire or cable, thereby insuring a secure attachment and a good electrical connection between the two wires. The figure shows the improved form of coupling. *a* is a cylindrical stud (made of brass or other suitable metal), having a transverse groove cut in it at one side to form a hook-shaped jaw, *b*, to receive the main wire or cable (bared at this point of its insulating envelope), and provided with a binding screw, *d*, screwing into or upon the stud, and with a hole, *e*, intersecting with the groove of the jaw, *b*, so that the wires placed in the jaw and hole respectively shall be in contact at the point where they cross one another. This hole, *e*, passes transversely through the stud, *a*, and the screw, *d*, is a male screw, screwing into a corresponding female screw, tapped in the stud, *a*, and screws up against the main wire or cable lying in the jaw, the act of tightening up the screw forcing the cable into the jaw and into contact with the branch wire, binding the latter tightly in the coupling, thus affording a secure and ready means of attachment and a good electrical connection.

5229. "Utilisation of electricity for lighting, &c." W. R. LAKE. (A communication from abroad by J. S. Williams, of Paris). Dated November 30. 4d. The first part of the invention relates to the development of light and heat by means of electricity, and also to the devices or apparatus to be employed therein or therefor. In order to produce light the inventor causes the electric current to pass through pulverized or granulated particles of conducting material. The material preferred is carbon, but other materials, alloys, or compound substances may be employed. The said material is enclosed in a transparent tube or case, which may be formed of glass or other suitable material, the space or chamber in which the particles are placed being of such form and dimensions as will be best suited for the development of light with economy. By completing the circuit through a conductor composed of particles, granules, or sections, a high resistance is obtained, and heat and light are generated successfully and economically. *(Provisional only.)*

5234. "Fire alarms, &c." W. T. BRAHAM. Dated November 30. 6d. The first part of this invention consists of an apparatus that shall on the occurrence of a fire in its immediate vicinity do any or all of the following acts, that is to say, it may sound an alarum, or alarums, transmit electric currents, or telegraphic signals, to any place or places desired, or turn on a supply of water, through a series of perforated pipes, for the purpose of extinguishing the flames. In carrying out this part of the invention the inventor employs, for the purpose of liberating, or setting the apparatus in motion, a vessel of convenient size, and of a material which is an insulator to electricity, as a glass tube, in which is placed some mercury. Upon the mercury is placed a suitable float, which, when a fire occurs, will be carried upwards by the expanding mercury and come in contact with and liberate a trigger which releases the apparatus. The apparatus is actuated by means of a weight or coiled spring, and when the spring or weight is released, as before described, the revolving barrel, by means of a chain winding round it, draws back a lever and liberates a heavy key, which in falling turns on the water supply. The barrel of the apparatus is connected by cords or wires with a distinct apparatus consisting of a driving barrel, the axis of which carries a wheel, upon which is mounted a revolver charged with blank cartridges. This wheel carries as many studs as there are chambers in the revolver; these, as they rotate, raise a lever, which as soon as a stud has passed it is forcibly driven by a spring on to the revolver nipple, and so explodes a cartridge. A lever having its fulcrum on the framing of the apparatus is connected at one end by means of a wire, or cord, to a bell, the other end of the lever is actuated by successive teeth, or pins, upon a wheel gearing with the driving wheel of the apparatus, so that the bell rings continuously until the apparatus has run down.

5272. "Electric lamps." W. F. KING and A. B. BROWN. Dated December 2. 6d. Relates to electric lamps of the kind giving light by the arc between carbon points, and it comprises simple and efficient apparatus for moving one or both carbons in a manner to compensate satisfactorily for their gradual consumption, and to keep the light very steady; also automatic apparatus whereby the current supplying two or more lamps is maintained without any (but possibly a momentary) interruption in the event of any one of the lamps ceasing to act, and whereby an extinguished lamp takes its place in the circuit again whenever it has been either automatically or otherwise adjusted or restored to a working condition. In carrying out the invention according to one modification, in which the carbons are in a vertical line, the upper carbon is held by the bottom end of a rod which passes up through a stuffing box into a vertical cylinder of size and length corresponding to the size and length of the carbons employed. A piston working in the cylinder is fixed or connected to the upper end of the rod, and the cylinder is filled with oil or other suitable liquid. The weight of the piston and rod and parts attached to it tends to force the liquid from the bottom end of the cylinder through a small passage or pipe leading to the top of the cylinder, and the rate of flow through this passage or pipe is automatically adjusted to correspond to the rate of consumption of the carbons. For the purpose of the adjustment the passage or pipe has for outlet at its upper end a small port in a horizontal port face, on which there rests a small slide valve; and this valve is connected to the iron core of a solenoid placed horizontally, and to an adjustable spring, the spring tending to open the valve and the solenoid to close it. The electric current working the lamp is made to pass through the coil of the solenoid; and when in consequence of too great separation of the carbon points and increased resistance the current passing through the solenoid is weakened it allows the spring to draw back the iron core and open the valve; and when the carbon points are too near the consequently stronger current causes the solenoid to act on the iron core so as to close the valve more or less and thereby diminish the rate of descent of the upper carbon. When the spring is properly adjusted the action of the parts is to keep the distance between the carbon points practically uniform. The liquid passing the valve flows into the upper end of the cylinder; and when a carbon has been consumed the rod and piston are raised for receiving a fresh carbon, the liquid passing from the upper to the under side of the piston through a check valve in the piston or in a separate passage; or the piston may be constructed so as on being pushed up to positively open a valve or passage through it for the liquid.

5600. "Electric lighting apparatus for railway trains, &c." SYDNEY PITT. (A communication from abroad by Eli T. Starr, of the City and County of Philadelphia, America.) Dated December 21. 6d. Relates to an improved organisation of instrumentalities for producing the lights which are required on board of railway trains for illuminating the track at night in advance of the locomotive, and for exhibiting a warning signal in the rear of the train, or for other analogous purposes. The inventor makes use of apparatus for generating or producing electric currents by the conversion of mechanical energy derived from the motion of the train itself into electricity, store a portion of the electricity so produced for use at such times as the train is not in motion, and apply the same to the development of light from electric lamps placed at suitable points upon the train. The invention consists in certain new organisations and combinations of parts or devices.

1882.

931. "Dynamo-electric machines." A. M. CLARK. (A communication from abroad by Henry Brinsley Sheridan, of Cleveland, America.) Dated February 25. 6d. The object of this invention is to produce dynamo-electric machines so constructed that the current induced in the armature will be without wide breaks and nearly continuous, and also to increase the efficiency of the said machines. The invention consists in a dynamo-electric machine constructed with its field magnets made oblong in cross section, and arranged in two series in a circle around the armature shaft with the poles of the opposing series facing each other, and arranged at a sufficient distance apart to receive the armature between them, the poles of each series nearly overlapping each other laterally, forming a nearly continuous magnetic field; also in the armature constructed of a hollow iron ring nearly rectangular in cross section, and with its sides converging or inclined inwards from the periphery towards the inner side; also in the hollow ring armature made with corresponding openings in its periphery and inner sides, and projections of uniform thickness upon its inclined or converging sides, whereby the outer part of the armature is brought nearer to the magnetic field of force than the inner part; also in the hollow ring armature made with two series of projections of different shape alternating with each oth-- the projections of the one series being made V-shaped or with ‹ verging sides, and the projections of the other series being made slightly inclined or converging sides and V-shaped ends, whe

channels or grooves of uniform width are formed to receive the helix coils; also in the combination with the armature having lugs and the armature shaft of the hubs having flanges, whereby the said armature will be firmly connected with the said shaft; also in the combination with the armature and the armature shaft of the stationary magnet cores and the helices, the said cores being placed spirally around the armature shaft and at an inclination with the said shaft, and the said helices being wound with their coils parallel with the magnetic field of force, whereby the field of force will be elongated in the direction of the armature's movement, as will be hereinafter fully described. Fig. 1 is a sectional side elevation of one form of the machine taken through the line, *w*, *w*, fig. 2. Fig. 2 is a sectional end elevation of

FIG. 1

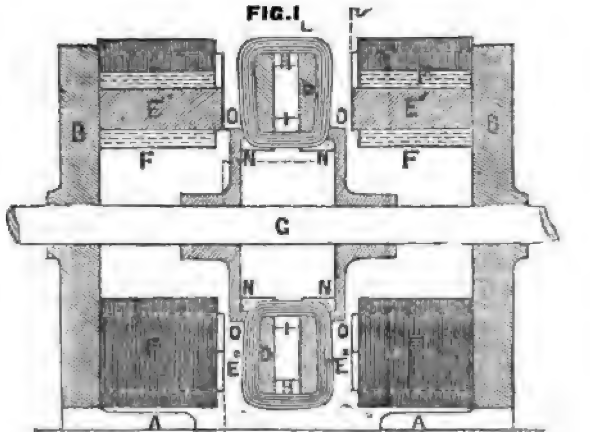
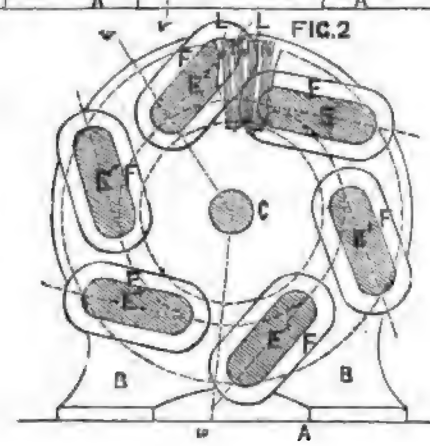


FIG. 2



the same taken through the line, *v*, *v*, fig. 1. A is the bed plate of the machine; B B are two standards attached to the bed plate, A, and having bearings in which revolves the shaft, C, that carries the armature. The standards, B B, also form the seats and supports for the stationary magnet cores, E^2, around which are wound helices, F, of insulated copper wire. The magnet cores, E, stand with their axes in a spiral line of convenient direction and pitch around the axis of the shaft, C. With this arrangement the stationary magnet cores present an oblong field of force to the armature, the length of the field of force depending upon the pitch of the magnet cores, E, and their inclination from the axis of the shaft, C. The magnet cores, E, are arranged with the longest diameters of their fields of force in the direction in which the armature revolves, by which arrangement the projections of the armature will remain longer in the fields of force, and the generated currents will thus be considerably increased. One of the magnet cores, E, with the surrounding helix can be one pole of an electro-magnet, or two or more of the said cores, E, can be connected on their faces by a plate, and thus form only one pole of an electro-magnet. The series of magnets are arranged in circles around the shaft, C, one series being attached to each frame, B. The magnet cores, E^2, are made oblong in cross section, and are arranged in inclined positions with reference to each other, so that they nearly overlap each other laterally, the side of one magnet being tangential to the rounded edge of the adjoining magnet, and so on throughout the series. With this arrangement the face of the pole of each magnet is arranged diagonally across the path of the armature ring in the plane of its rotation. This construction brings the magnets into such positions that each section coil of the armature will pass upon the pole of each magnet at the instant it leaves the pole of the preceding magnet, so that the current induced in the armature will be without wide breaks and will be nearly continuous. With this construction the armature can be revolved in either direction.

THE ANGLO-AMERICAN TELEGRAPH COMPANY.—At a meeting of the board of directors, it was resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending June 30th, 1882, of 15s. per cent. on the ordinary stock, and 30s. per cent. on the preferred stock, both free of income-tax, payable on August 1st, to the stock-holders registered on the books of the company on July 7th, 1882.

THE WESTERN UNION TELEGRAPH COMPANY.—This company has declared a quarterly dividend at the rate of 6 per cent. per annum upon its stock, payable on July 15th. The surplus proposed to be carried forward after payment of this dividend is unusually large.

EASTERN EXTENSION TELEGRAPH COMPANY.—A dividend of 2s. 6d. per share for quarter ended 31st March, will be payable on July 15th.

EASTERN TELEGRAPH COMPANY.—Notice is given that subject to the final audit, the accounts show, after placing the sum of £75,000 to reserve, a balance sufficient to pay the fixed dividend of 3s. per share, equal to 6 per cent. per annum on the preference shares, and a final dividend of 2s. 6d. per share, with a bonus of 1s. per share on the ordinary shares, both free of income-tax; making, with previous payments on account, a dividend for the year ending March 31st, 1882, of 5½ per cent. on the ordinary shares. A balance of about £1,000 is carried forward.

EASTERN AND SOUTH AFRICAN.—The interest on the 5 per cent. mortgage debentures now due will be paid by Messrs. Barclay, Bevan & Co.

CUBA SUBMARINE TELEGRAPH COMPANY.—The directors of this company state that, after providing for the dividend on the preference shares and placing £3,950 to the reserve fund, they have resolved to recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, free of income-tax, leaving £2,146 to be carried forward to the current half-year's account.

APPLICATION has been made to the Stock-Exchange Committee to appoint a special settling day in and to grant a quotation to the following securities:—Metropolitan Brush Electric Light and Power Company (Limited), and Railway Electric Appliances Company, shares.

QUOTATIONS have been granted to the Great Western Electric Light and Power Company, and to the Indian and Oriental Electric Storage and Works Company.

QUOTATION of the Brush Electric Light and Power Company of Scotland (Limited), has been deferred.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. July 5	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	25 -26	26.25½.6¼.6.5¾.¼.½.6
		Do. Do.	10	45 - 50	
150,000	1	Electric Light and Power Generator Co.	1	½- 1	
25,000	5	Great Western Electric Light & Power Co.	2	1½- 1¾	
24,380	5	Hammond Electric Light & Power Supply Co.	2½	10½- 11½	11¼.11.10¾
40,000	5	Indian & Oriental Electrical Storage Co.	2	2 - 2½	2¼
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	52 - 53	
2,441,800*l*.	Stk.	Do. Preferred } Def'd. receiving no div. until	100	82½ 83½	82½.1.2½
2,441,800*l*.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	22½- 23	22¾
130,000	10	Brazilian Submarine, Limited	10	11¼- 11¾	11$\frac{7}{16}$
16,000	10	Cuba, Limited	10	9¾- 10¼	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6¼- 6¾	6½
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11¾- 12¼	
100,000*l*.	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10½- 10¾	10½.$\frac{7}{16}$.$\frac{9}{16}$
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	13½.$\frac{7}{16}$.½.$\frac{9}{16}$
232,000*l*.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	102 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11 - 11½	11¼.⅜.½
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	106 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb 1900	100	102 -105	xd.
140,000	100	Do. do. registered, repayable 1900	100	102 -105	xd.
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l*.	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	103 -105	xd.
345,700*l*.	100	Do. do. do. To Bearer	100	102 -105	xd.
22,060	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¼- 6½	
163,209	10	Do. 6 per cent. Preference	10	12¼- 12½	12$\frac{7}{16}$.½
125,000	10	Great Northern	10	12½- 13	
100,000*l*.	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	25½- 26½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,050	10	Mediterranean Extension, Limited	10	2 - 2½	
8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	265 -275	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	100 -105	
37,350	12	Telegraph Construction and Maintenance	12	29½- 30½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	103 xd.
188,750	5	Do. 2nd Bonus Trust Cert.	5	1¼- 1½	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	6½- 7½	7
200,000*l*.	100	Do. 6 per cent. Debentures "A" 1910	100	107 -112	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	99 -102	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds	$1,000	121 -126	
1,030,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	8 - 8½	8½
4,669	10	Do. 6 do. 2nd do.	10	6½- 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1¾	1$\frac{9}{16}$.½
200,000	1	Oriental Telephone Co., Nos. 100,000 to 200,000	½	⅝- ⅞	
100,000	5	United Telephone Co.	5	12½- 13½	12¾.⅞.⅞

The last prices on July 5th of Electric Light Shares not officially quoted were as follows:—Australasian, ½ dis. to ½ prem.; Eastern Electric Lights, 4 to 4½; Midland, ½ dis. to par; Scotch, 1 to 0½ dis.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 242.

THE ELECTRIC LIGHT IN THE CITY OF LONDON.

SOME interesting statistics are to be found in the recently-issued Report to the Streets Committee, by Mr. William Haywood, the engineer and surveyor to the Commission of Sewers. It deals of course exclusively with the experiments of the past year, commencing from the 1st of April, 1881, and ending on the 31st March of the present year. It is well known that the Electric Light and Power Generator Company (Maxim-Weston) did not commence on the strict terms of their contract until the 27th of April of this year, therefore the matter contained in Mr. Haywood's report is chiefly confined to the systems of Messrs. Siemens Brothers and the Anglo-American Brush Company. One of the most interesting items in connection with the use of the electric light in the City is that relating to its defects and failures. In the Brush district were 33 lamps, each assumed to be alight for 4,300 hours during the twelve months, this being equal to a total of 141,900 hours' lighting of a single lamp. The total number of the failures which happened to this system from all causes amounted to 660, counting each failure each night separately, and the aggregate duration of such defects equalled 3,142 hours' burning of a single lamp, or about 2·21 per cent. of the entire lighting of the district for the year. The causes assigned for these failures are very numerous, amongst them being many which will probably not be likely to occur again, such as: lace of driving-band broke; switched out maliciously; changing the working power of circuit from one motor to another; defects in carbons; carbon-rod sticking; top carbon falling from socket; neglect in trimming; bad insulation of cables; carelessness of men employed on circuit; defective mechanism of lamp, &c., &c.

The total number of failures from much the same reasons as above, chronicled for the system of Messrs. Siemens—having 34 lamps in action, and equalling a total of 146,200 hours' lighting from a single lamp—were 320, or approximately only half of those credited to the Brush, their aggregate duration, however, being only 832 hours of a single lamp, or about 0·57 per cent. of the entire lighting of the district for twelve months.

Speaking roughly, there occurred in the Brush system a defect of long or short duration in something less than two lamps nightly, and in that of Siemens Brothers a similar defect in something like one per night. In both systems failures happened through bad insulation, the first cable of the one not being sufficiently good to begin with, and that of the other being damaged by a barge, part of the cable being beneath London Bridge. Although these partial failures were numerous, the result at the end of the year was really better than might have been expected, even by those who are the most conversant with the management of the apparatus connected with the electric light. Even gas, however, has a bad record against it in this respect, for out of a total of 3,225 lamps, the number of defective lights observed in 1881 amounted to no fewer than 2,509, and this only includes burners, in which the defect is very noticeable. This number, which according to the Report was much in excess of what is usual, is attributed to the long continued and severe frosts.

Whenever any accident occurred to the electric lamps but little inconvenience was felt by the public, as arrangements were made with the gas company for burning gas where these partial interruptions happened. The expense of this was borne by the electric lighting contractors, and in the case of Brush the amount came to £129 14s. 7d., and for Siemens £122 9s. 7d.

The electric lamps were alight in the day-time during the fogs of December 9th last, and also on the respective dates of the 18th, 25th, and 29th of January, together with the 2nd, 3rd, 6th, and 7th of February. The cost of the electric light during these fogs was as follows:—Brush, £25; Siemens, £21 3s. 9d.

It is only necessary to mention that the Commission of Sewers arranged with the Brush Corporation for a further period of twelve months lighting, at a cost of £800, being £140 in excess of the charge for the preliminary year's work. Messrs. Siemens Brothers requiring for a continuance of their contract £1,330 in excess of their original price; their offer was declined, and the district for the present returns to gas.

A second report from the Streets Committee relates to proceedings relative to the applications for an extension of the electric lighting experiments. According to the abstracts of tenders prepared by Mr. Haywood, and received for lighting the four districts set apart for this purpose, it appears that there are seven contractors desirous of obtaining the work. Their names are as follows:—G. D. Cardew, employing G. H. Long's patent electric lamps and machines; the Electric Light Engineering Company, with the arc lamp of Mr. A. A. Common, but machines not described; the Electric Light and Power Generator Company, with the Weston machines and arc lamps, as now in use along Queen Victoria Street; Mr. A. L. Fyfe, lamps and machines not described; James Fyfe, with two tenders for the Pilsen arc and the Joel semi-incandescent lamps respectively; the Hammond Electric Light and Power Supply Company, using Brush machines and lamps; and last, the Laing Electric Light and Power Company, proposing to employ the Laing machines and lamps. The second and third mentioned contractors stipulate that they should have permission to light private premises, the Electric Light and Power Generator Company, however, tendering for No. 1 district only.

We gave in our last issue an extract from a letter written by Mr. Alexander Peebles, relating to the prices quoted for the various districts by the competing companies. We may add that for district No. 1 the highest and lowest tenders are those of the Electric Light and Power Generator and the Hammond Electric Light companies, with £5,750 and £2,190 respectively. For district No. 2, G. D. Cardew and the Laing Company, with £4,270 and £2,350, are respectively highest and lowest. In tendering for No. 3 district James Fyfe, with the Joel system, £3,800 is highest,

and the Hammond and Laing Companies, with the same estimate of £2,470, lowest. For No. 4 district, James Fyfe, with the same system, is again highest—£4,350, and the Laing Company, with £2,920, lowest. These tenders are all for the total cost of a twelvemonth's trial. It is only fair to add, however, in the case of Mr. Fyfe, with the Joel and Pilsen systems, that he would, if permitted to light private premises, make the charge for street lighting the same as the gas saved, plus 20 per cent.

The percentage of variation in the estimates sent in will be found in the letter of Mr. Peebles before referred to, and this variation bears out, to a certain extent, the following extract from the *Globe*:—

It ought, one would think, to be possible, after all the investigations which have taken place, to say once for all whether electric lighting or gas lighting is the cheaper, but if we may judge from a long letter sent to us by Mr. H. Saxon Snell, the controversy is still very much *sub judice*. The tenders for a given job, obtained by Mr. Snell from three several electric light companies, differed very much as contractors' tenders are apt to differ, and all were far beyond what, according to Mr. Snell, the cost of gas would be.

The estimated cost for lighting the four districts, taken in rotation, is £551, £363, £341, and £612.

The Streets Committee conclude their report in the following manner:—

Looking at the experiments which the Commission have already carried out, and the great cost of extending the same, as shown by the offers now submitted, we are not prepared to recommend your Honourable Court to proceed further in the matter at present, the more so as by the bill now before Parliament, and draft amendments suggested by the Board of Trade, it is proposed to give power to the local authorities to supply electricity, not only for public but for private purposes, or to acquire compulsorily the undertakings of other parties after fifteen years from the passing of the Act under which they may be empowered, and until Parliament has decided the principle upon which electric lighting generally shall be permitted, we consider it undesirable to incur further expense beyond that to which the Commission are already committed by the experiments now in operation.

THE EDISON DYNAMO-ELECTRIC MACHINE.

[We extract from the excellent journal of the Franklin Institute of America the following description of the Edison steam dynamo, a paper on which was read by T. A. Edison, Ph.D., and Charles T. Porter, at the Philadelphia meeting of the American Society of Mechanical Engineers, April, 1882. Containing, as it does, much that is new regarding what is known here of the performance of these machines, it will be welcome to those of our numerous readers interested in electric lighting. The original paper contains a perspective illustration of the combined engine and machine, which it is not necessary to reproduce, as the Edison machine has already been given by ourselves (see "ELECTRICAL REVIEW," November 5th) and other journals in this country. There are also several sketches of mechanical details, and five indicator diagrams taken from the engine, which need only be referred to.]

THE central Edison station of the first district in New York City will, when fully equipped, be supplied with twelve dynamos, each of which is nominally rated as a 1,200 light machine, at 16 candle-power incandescence, but is capable of supplying 1,400 lights of this power continuously, and with high economy, without heating the armature or burning or injuring the commutator or brushes. This increased capacity is due to improvements in the lamp itself.

The armature of each dynamo is driven by a Porter-Allen engine, of $11\frac{3}{16}''$ diameter of cylinder, by 16" stroke, directly connected, and making 350 revolutions per minute, giving a piston travel of 933 ft. per minute.

The steam is supplied by eight Babcock and Wilcox boilers, of 2,000 aggregate horse-power, and which will work under a pressure of about 120 pounds. These occupy the basement of the building. Over them, the first and second floors being removed, an iron superstructure is erected entirely separated from the walls of the building, and on this the combined dynamos and engines are placed.

One-half of this equipment is now nearly ready for service, and the remainder is expected to be completed during the coming season.

The armature of the dynamo is of the form commonly known as the Siemens armature, but in its construction and "connecting up" it differs radically from all others.

The foundation of the armature, or the iron core which is built upon the shaft, is made up of sheet-iron discs, separated from each other by sheets of tissue paper, and bolted together. This has all the advantages of a solid iron core in strengthening the magnetic field, while it completely prevents the great loss of power by local currents, which would circulate in the iron if it were solid. In the place of insulated wires, the cylindrical face of the armature is made up of heavy copper bars, trapezoidal in section, each bar being insulated, and also separated from its neighbours and from the iron core underneath by an air space.

The connection between the bars on opposite sides of the armature, to form the electrical circuit, is made by copper discs of the same diameter as the core. At each end of the core are one-half as many of these copper discs as there are bars, each disc being insulated from its neighbours, and the whole being bolted together in such a manner as to form, with the discs of sheet-iron constituting the core, one solid mass. Each disc is formed with projecting lugs on its opposite sides, to which the two bars are connected.

The connections between the opposite surfaces of an armature are of no benefit in generating an electric current, but are a necessary evil, introducing useless resistance into the circuit. By using for this connection copper discs in the manner described, a great weight of copper is disposed in a limited space, and so this useless resistance, and consequent loss of energy, is reduced to a minimum.

This method, moreover, reduces the work to a simple machine construction, in which all the parts are duplicates, and the operations can be much cheapened and facilitated by the use of special tools.

The spaces between the armature bars admit of a free circulation of air, thereby preventing the accumulation of heat, and increasing to an enormous degree the capacity of the machine. The armature is at intervals wound with piano wire over the bars to resist the centrifugal force developed by their revolution.

The commutator and brushes of an electrical machine are the parts subject to the greatest depreciation. In this machine all parts of the end of the armature are so constructed as to be easy of access, and they can be quickly and cheaply repaired, or removed and replaced by new parts, when necessary. Any accident would require but a short stoppage for repairs.

Provision is made for keeping a continuous and rapid circulation of air over the entire face of the armature.

This armature is 27·8" in diameter by 61" long. The commutator adds 18" to this length, and is itself $12\frac{3}{4}''$ in diameter. The armature shaft is of steel, $7\frac{1}{4}''$ in diameter, having a total length of 10′3″. The journals are $6\frac{1}{2}''$ in diameter by 15" long, and run in Babbit metal bearings in pillow blocks of the box form, giving the greatest stiffness with minimum of weight.

Provision is made for continuous water circulation underneath the boxes, and for continuous lubrication, with traps to prevent the creeping of the oil along the shaft and reaching the commutator, and drains to receive it as it runs through the bearings and convey it to a drip-pan.

The magnet is made up of two immense cast-iron "pole-pieces," between the semi-cylindrical faces of which the armature revolves, twelve cylindrical soft iron cores attached to these pole-pieces, and made magnetic by an electrical current circulated in the wire wound around them, and four soft iron keepers connecting the back ends of the cores. Eight of the cores are attached to the upper pole-piece, and four to the lower one.

The width of these "poles" is 49", and their height $61\frac{1}{4}''$. The length of the twelve soft iron cores is 57", the diameter

of the eight upper ones is 8″, and of the four lower ones 9″. The four soft iron keepers are each 11″ wide, 9″ in thickness, and the total length of the magnet is 94″.

The magnet is insulated by cast zinc bases 3″ in thickness. The weight of the dynamo is as follows:—

Armature and shaft - -	9,800 lbs.
Two pillow blocks - - -	1,340 „
Magnet, complete - - -	33,000 „
Zinc bases - - - -	680 „
Total - - -	44,820 lbs.

The copper is distributed as follows:

In the armature bars - -	590 lbs.
„ „ discs - -	1,350 „
„ magnet wire - -	1,500 „
Total - - -	3,440 lbs.

Mr. Edison was early impressed with the conviction that to give steady and reliable motion to these armatures it would be necessary to connect an engine to each one of them directly. This combination has been termed by him the "steam dynamo."

In adapting the Porter-Allen engine to this service, a special construction in some respects was found to be called for. These special features will be briefly described.

It seemed important to avoid a rigid connection between the engine and the armature shafts, which would require the entire series of bearings to be maintained absolutely in line. In place of this, therefore, a self-adjusting coupling has been introduced, which permits of considerable errors of alignment without any abnormal friction being produced in the bearings.

The point of difficulty was the backlash, the engine having no fly-wheel, except the heavy armature itself, which was to be driven through the coupling. Provision was made for taking this up by steel keys of a somewhat peculiar form, between which the tongues of the coupling move freely, while they themselves are immovable. These keys are held between set screws threaded in wrought iron rings covering the flanges on the ends of the shaft. All the faces liable to move upon each other are oiled from a central reservoir. This coupling is a very compact affair, without a projection anywhere above its surface, and gives every promise of completely answering its purpose.

The engine is made with a forked bed and two shaft bearings and a double crank, and so is completely self-contained.

The shaft having no support beyond these bearings on either side, unusual stiffness was required in the crank-pin to prevent deflection under the great strains to which it is subjected.

A novel form of pin was proposed by Mr. Richards, which is found to possess all the rigidity required. It is provided with flanges which are let into each crank, and held each by four screws, while the shanks of the pin are also forced firmly into the cranks.

Special appliances enabled the work of putting the cranks together in this manner to be done with extreme and uniform accuracy.

The engine is so arranged as to have the valve gear on the side furthest from the dynamo. The engineer has not to go between the engine and dynamo, when running, for any purpose.

The connecting-rod is of steel, and the crank-pin boxes are formed directly in the end of it.

This end is finished from a solid forging, and chambered out for Babbit metal. The bolts are then fitted, after which it is parted and holes are drilled for holding the Babbit securely.

In the connecting-rods for single crank engines of this type permanent length of rod is secured by forming the crank pin end solid, and taking up the wear by a wedge closing up the inside box. In these double crank engines this construction is impracticable, but the same object is attained by forming the crosshead end in a manner by which the strap is made permanent and the inside box is closed up by a key bearing against a steel plate.

The weight of the reciprocating parts of this engine is as follows:—

Piston, with rod - - - - - -	83 lbs.
Crosshead - - - - - - -	42 „
Connecting-rod - - - - - -	109 „
Total - - - - - -	234 lbs.

The initial acceleration of this mass or the force required, on the dead centres, to give it the motion necessary to relieve the crank from strain, is as follows:—

$$350^2 \times \cdot66 \times \cdot000341 = 27\cdot57,$$

or 27·57 times the weight of the mass, which gives

$$234 \times 27\cdot57 = 6451 \text{ lbs.}$$

The formula is $r^2\, l\, c$, when

r^2 = the revolutions per minute;
l = the length of the crank in decimals of a foot; and
c = the co-efficient of centrifugal force.

The connecting rod is 48″, or 6 cranks, in length. This affects the initial acceleration, making this to be on the dead centre farthest from the crank 7,526 lbs., and on the dead centre nearest to the crank 5,376 lbs., a difference of 40 per cent.

The area of the cylinder is 98·2 square inches.

The area of the piston rod, $1\frac{3}{4}$ in. diameter, is 2·4 square inches, leaving area of cylinder at crank end 95·8 square inches.

The initial accelerating forces are therefore as follows, viz.: at the end of the cylinder farthest from the crank 77 lbs., and at the end of the cylinder nearest to the crank 56 lbs., on the square inch of piston area.

The counterweight was after some trials fixed at 135 lbs. This leaves 99 lbs. of the reciprocating parts running unbalanced. It is found that this is not sufficient to disturb the stability of the engine, while on the other hand the counterweight is not so great as to exert an objectionable strain in the vertical direction.

The total weight of the engine is 6,445 lbs.

The engine and dynamo are mounted on a cast-iron base plate, made for convenience in two parts, and bolted together.

The dimensions of this base plate are as follows: length 14 ft., width 8 ft. 9 in.; and its weight is 10,300 lbs. The entire weight is therefore as follows:—

Base plate - - - - - -	10,300 lbs.
Dynamo - - - - - -	44,800 „
Engine - - - - - - -	6,450 „
Total - - - - - -	61,550 „

The last and most careful test of one of these dynamos gives the following results, as shown by the indicator diagrams; scale 80 lbs. to the inch.*

The lamps used in all the trials were of the older construction, of which $8\frac{1}{2}$ lamps, at 16 candle-power incandescence, require one horse-power of electrical energy.

Since these were placed for experimental uses, improvements in the lamp have increased their economy, so that one horse-power is sufficient to maintain fully 10 of the present lamps at 16 candle-power incandescence.

	Horse-power.
Diagram No. 1 shows the friction of engine and dynamo at 350 revolutions per minute, requiring	13·63
Diagram No. 2 shows the resistance with the magnet circuit on = - - - - -	19·17
Field 5·78 ohms, 103 volts.	
The increased resistance due to the magnets was -	5·54
Of this, the calculated energy developed in the magnets was $\dfrac{103^2 \times 44\cdot3}{5\cdot87 \times 33{,}000}$ = - - - -	2·46
Leaving energy to be accounted for by local currents in iron core of armature, and in armature bars - - - - - - - - -	3·08

* As many persons might doubt about these diagrams having been really taken from any engine and by any indicator at this speed, we have examined the originals taken by a Tabor indicator, and can vouch for their accuracy.—ED. J. F. I.

Diagram No. 3 shows the work done in maintaining 300 lamps.

These, in the ratio of $8\frac{1}{2}$ to 10, were equal to 353 lamps of the present construction. The pressure was maintained also at 102 volts, representing 25 candle-power, in place of 98 volts, representing 16 candle-power incandescence, which requires the number of lamps to be increased in the ratio of 102^2 to 98^2, or to 382 lamps.

The pressure at the armature was 104 volts, showing a loss in the conductor of 2 volts, which would increase the number of lamps as 104 : 102.*

The total correction is therefore as follows :—

$$300 \times \frac{10}{8{\cdot}5} \times \frac{102^2}{98^2} \times \frac{104}{102} = 389 \text{ lamps.}$$

The power exerted was - - - - 60·6 horse-power.
Which gives to the indicated horse-power

$$389 + 60{\cdot}6 = 6{\cdot}42 \text{ lamps.}$$

The magnet circuit had now a resistance of 5·28 ohms with 104 volts pressure, representing

$$\frac{104^2 \times 44{\cdot}3}{5{\cdot}28 \times 33{,}000} = 2{\cdot}75 \text{ horse-power.}$$

Substituting this in place of 2·46 horse-power in the first trial, we have 19·46 horse-power, which, deducted from 60·6 horse-power, leaves net 41·14 horse-power.

This gives 389 ÷ 41·14 = 9·45 lamps per horse-power.

Diagram No. 4 shows the work done in maintaining 700 lamps.

The pressure at the lamps was maintained, as in the preceding trial, at 102 volts, which required at the armature a pressure of 105 volts.

The total correction in this case is therefore

$$700 \times \frac{10}{8{\cdot}5} \times \frac{102^2}{98^2} \times \frac{105}{102} = 919 \text{ lamps.}$$

The power exerted was - - 115·83 horse-power, giving to the indicated horse-power,

$$919 + 115{\cdot}83 = 7{\cdot}93 \text{ lamps.}$$

The resistance of the magnet circuit was now 4·78 ohms, with 105 volts pressure, representing

$$\frac{105^2 \times 44{\cdot}3}{4{\cdot}78 \times 33{,}000} = 3{\cdot}1 \text{ horse-power.}$$

Substituting this in place of 2·46 horse-power in the first trial, we have 19·81, which, deducted from 115·83 horse-power, leaves net 96·02 horse-power.

This gives 919 + 96·02 = 9·57 lamps per horse-power.

Diagram No. 5 shows the work done in maintaining 1,050 lamps.

The pressure at the lamps was maintained in this trial at only 99 volts, but this required at the armature a pressure of 108 volts, showing a loss of 9 volts in conduction.

The total correction in this case is thus

$$1050 \times \frac{10}{8{\cdot}5} \times \frac{99^2}{98^2} \times \frac{108}{99} = 1375 \text{ lamps.}$$

The power was - - - - - 168·4 horse-power, giving to the indicated horse-power

$$1375 \times 168{\cdot}4 = 8{\cdot}16 \text{ lamps.}$$

The resistance of the magnet circuit was now 8·28 ohms, with 108 volts pressure, representing

$$\frac{108^2 \times 44{\cdot}3}{8{\cdot}28 \times 33{,}000} = 4{\cdot}77 \text{ horse-power.}$$

Substituting this in place of 2·45 horse-power in the first trial, we have 21·48 horse-power, which, deducted from 168·4 horse-power, leaves net 146·92 horse-power.

This gives 1375 ÷ 146·92 = 9·36 lamps per horse-power.

* The conductors were insufficient, occasioning a loss, that increased with the increase in the number of lamps

It will be seen that the losses of efficiency due to undiscovered resistances are only

In the first case, 10 — 9·45 = ·55 horse-power per lamp.
In the second case, 10 — 9·57 = ·43 „ „
In the third place, 10 — 9·36 = ·64 „ „
Averaging 5·4 per cent.

The friction in the journals of the armature, when driven in this manner, does not increase with the resistance, and, on account of the action of the reciprocating parts of the engine, that in its bearings is also nearly a constant quantity, whatever the load may be.

The above figures show this very clearly, the subtraction of the friction diagram in each case exhibiting substantially the same net power per lamp.

KETTELL'S INDIVIDUAL TELEPHONE CALL AND SIGNAL.

THE progress which telephonic communication has made in England is but small compared with that made in America. The network of wires which has been spun all over the business portion of the Metropolis, and to some extent outside the City limits, would seem to contradict this statement; but it is only necessary to mention the fact that Worcester, a city in Massachusetts, of 63,000 inhabitants only, has more subscribers in telephonic communication than have all the exchanges in London, when it will be seen at once that what we say is correct. In countries where the use of the telephone is so extensive it is but natural that every effort should be made, not only to render the communication as effective but also as cheap as possible, hence it is that we find here so many telephonic exchange patents taken out by inventors in America, for cheapness of communication, to a very great extent, depends upon the exchange system employed.

Up to the present the arrangements of the exchanges in this country have been of the simplest character : every subscriber has a wire in direct communication with an exchange office, at which place he can be switched through to any subscriber he may require ; if it should happen that there are, say, six subscribers who are at a short distance apart on a direct line from the central office, still, with the present system, each of these subscribers must have a separate wire. Now it is evident that any device by which these six subscribers could be simply looped in on a single wire common to all, must lessen the outlay necessary to establish the communication, and must enable the latter to be supplied at a less rental than that demanded at present. It is of course necessary that the means by which the object in view is carried out be of a much less cost than that which would be required for the erection of a number of wires, for the lessening of the rental to a subscriber must be sufficient to compensate him for one small disadvantage inherent in a system in which a number of instruments are placed on one circuit, namely, that one subscriber has to wait until another subscriber has terminated his use of the circuit on which the two are looped, and has left the line clear. As a rule, however, the period of waiting does not exceed three minutes, a length of time which it is hardly worth while taking into consideration.

The proof of the pudding is the eating, and the system which we are about to describe has, by practical use over a period of a year and a half, proved that such an arrangement as that of looping several subscribers (as many as 10 have been so looped) on one wire, can be adopted with perfect success.

The solution of the problem has been more than once attempted, but, we believe, with but indifferent success. The system of Mr. Kettell is, in our opinion, the best which has yet been brought into practical use, and promises to be extensively employed.

The devices by which the apparatus is worked are of great mechanical ingenuity, and are very suggestive of applications to other purposes, and even for this reason the system is worthy of being described.

In order to explain the action of the instruments, it will

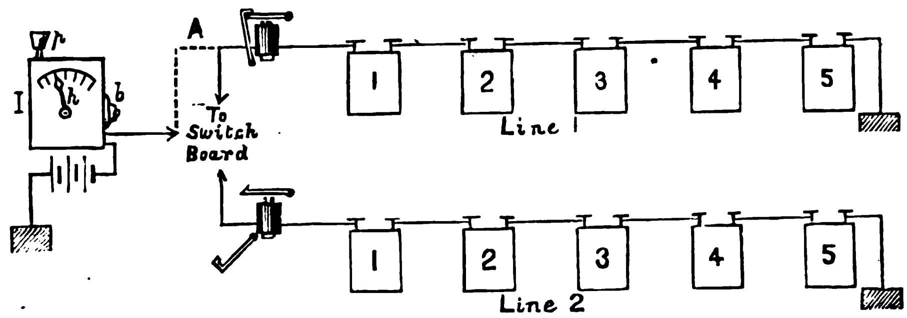


FIG. 1.

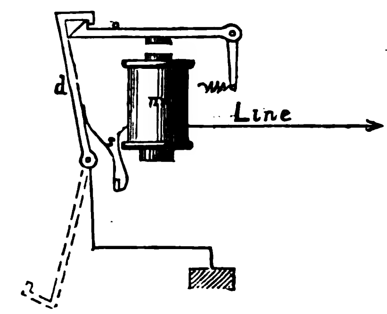


FIG. 2.

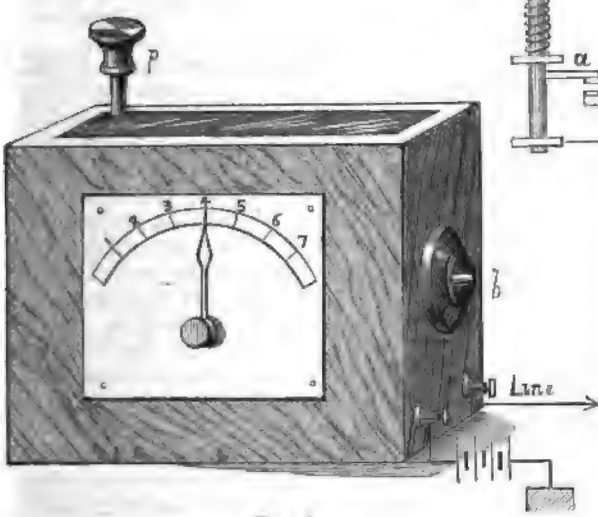


FIG. 3.

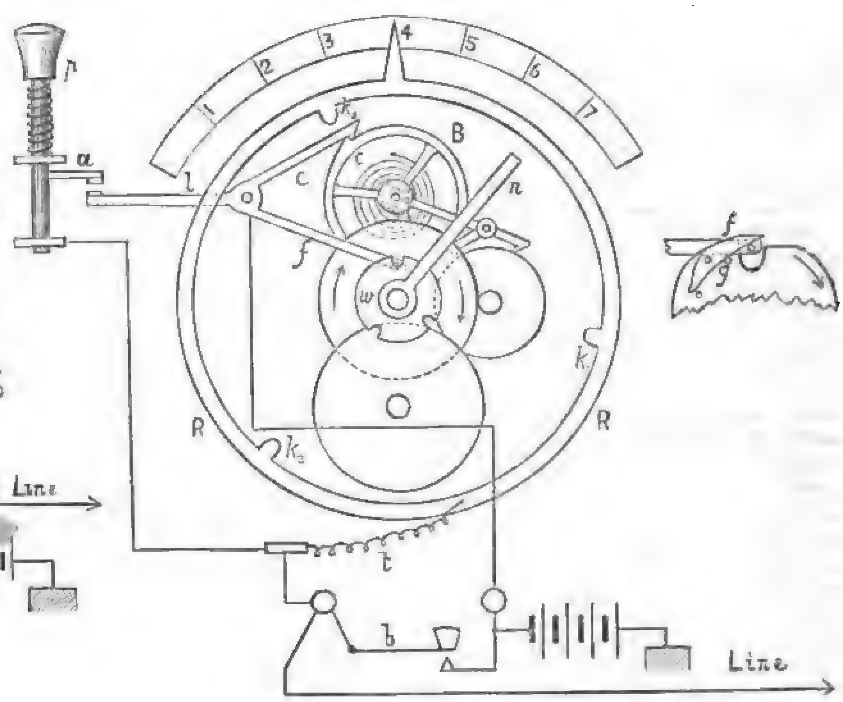


FIG. 4.

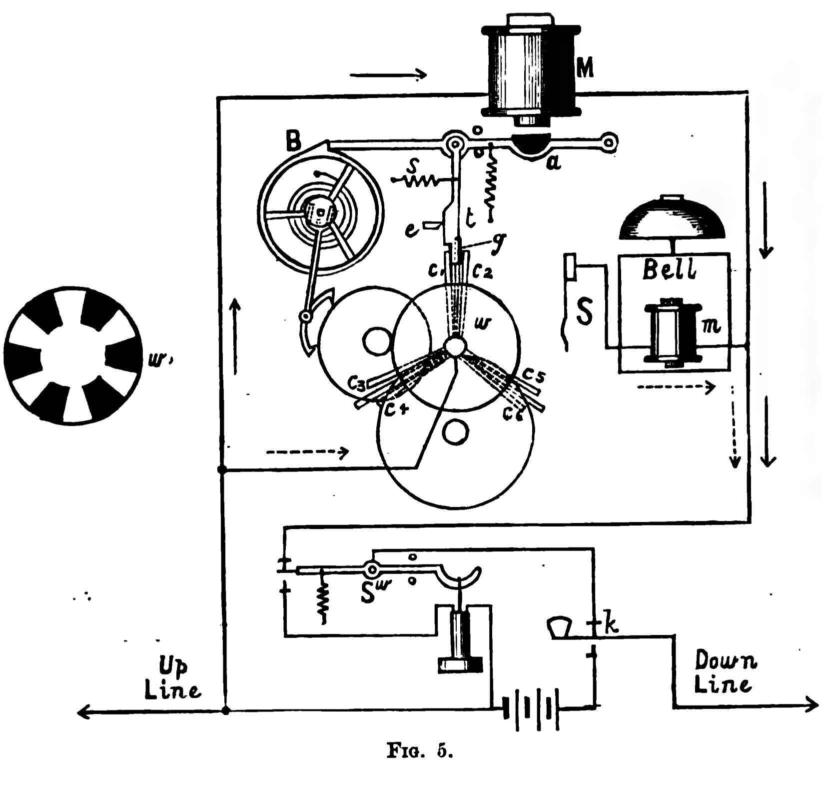


FIG. 5.

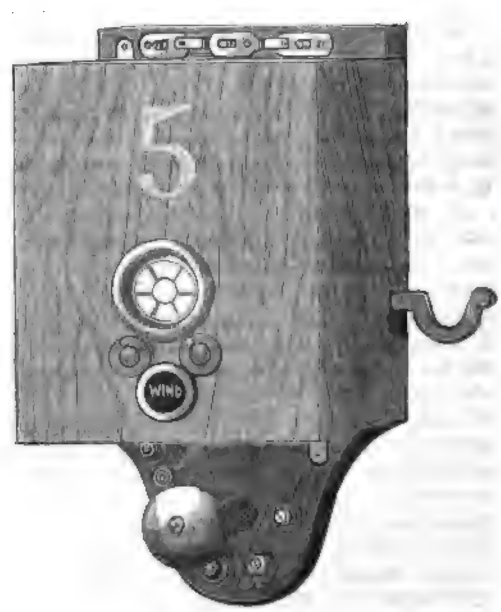


FIG. 6.

be advisable to consider the general arrangement of the system :—

Fig. 1 shows two lines running into a central exchange at A, each line having 5 subscribers looped into it; there may of course be any number of lines with a number of subscribers on each, but two will be sufficient for the purpose of the description.

Suppose now that subscriber 3, on line 2, wishes to communicate with subscriber 5, on line 1, then the following operations take place :—Subscriber 3 presses a push-button attached to his instrument, and thereby sends a current through all the instruments on the circuit, and also through a drop indicator at the central station, thus calling the attention of the latter. The indicator is of the usual form, but is arranged as shown by fig. 2, that is to say, the circuit from the electro-magnet, instead of passing direct to earth, goes to the latter through the medium of the contact spring, *s*, and the drop, *d*, so that when the latter has fallen to the position shown by the dotted line, the circuit becomes disconnected, and no more currents can be sent by pressing the press-button. The current which passes through the instruments of the various subscribers sets free some mechanism, which causes a small indicator on each instrument (seen just below the 5 in fig. 6) to turn and indicate that the line is occupied.

As soon as the central exchange station receives the call he switches his telephone in circuit with the line and communicates with the subscriber, who announces his number and also states with whom he wishes to communicate. As we have before said, let it be subscriber 5, on line 1. The exchange station now switches the apparatus, I (fig. 1), shown in outward form by fig. 3, on to line 1 (this connection is represented by the dotted lines in fig. 1); he then sets the hand, *h*, to indication 5, and depresses the push, *p*. The result of this is to ring the alarum of subscriber 5, and to turn the indicators of the instruments of *all* the subscribers to the position which indicates that the line is occupied; *but the alarums of the subscribers other than number* 5 *do not ring*. As soon as the exchange station observes that the mechanism of his apparatus (fig. 3) has ceased to run, he disconnects the latter and switches line 1 in communication with line 2; the subscribers thus put into connection communicate with each other. At the end of three minutes (which is the time allowed for a subscriber to converse) the exchange disconnects the two lines, and having again connected the instrument, I (fig. 1), to line 1, he depresses the button, *b*, once; this sets the indicators of all the subscribers to the position indicating that the line is clear; line 1 is then connected again to its drop indicator, and the instrument, I, is connected to line 2, the button, *b*, depressed once, the instrument, I, disconnected, and line 2 connected again to its drop indicator.

It will be evident that the peculiarity of the apparatus consists: 1st, in the arrangement by which the currents (*two* currents, as will be seen) sent by the depression of the stud, *p*, move the indicators of all the instruments to the position indicating that the line is occupied; 2nd, in the arrangement by which the alarum of only one subscriber is sounded; 3rd, in the arrangement by which the depression of the push, *b*, sets all the indicators to "line clear."

Fig. 4 shows the internal arrangements of the apparatus (fig. 3) at the exchange station. Fig. 5 shows the internal arrangements of the instruments at the subscribers' offices; an outside view of one of these instruments is shown by fig. 6. It must be understood that figs. 4 and 5 only show the general arrangements of the apparatus, the actual forms of the latter differ slightly in detail from the figures, though the general principles are identical.

Referring to fig. 4, let us suppose the stud, *p*, to be depressed and then immediately allowed to rise again. When the depression takes place, the projecting piece, *a*, comes in contact with the lever, *l*, and as the zinc pole of the battery is connected to *l*, and the line to the push, *p*, a current flows out to line, but ceases immediately the pressure is taken off *p*. The movement of the push has, however, depressed the lever, *l*, and caused the hook at the end of the prong, *e*, to disengage from the projection, *c*, on the balance-wheel, B. This balance-wheel is in gearing with a train of wheels driven by a strong spring—the whole mechanism of an American lever clock, in fact. The balance being released, the clockwork mechanism starts off in action. Now the movement of lever, *l*, also lifts a pin at the end of the prong, *f*, out of a notch in wheel, *w*, but as the movement of this wheel is comparatively slow, the pin would drop again into the notch and stop the train of wheels unless previous to *p* being allowed to rise, the wheel, *w*, has moved round through a few degrees; practically, however, the depression of *p* being only momentary, the wheel, *w*, will not have turned sufficiently to make the pin drop on to the circumference of *w*, instead of into the notch; so to avoid this difficulty the device shown to the right of the figure is adopted. On the face of the wheel, *w*, and near the circumference, there is set at each notch a small pawl, *g*, which falls to the position shown, by its own weight; when the prong, *f*, rises, the pin lifts up the pawl and, on clearing it, the latter drops back to its original position, thus closing, as it were, the notch and preventing the pin of the lever dropping back again. Supposing now the wheel, *w*, continues to rotate with the pin of the lever resting on its circumference, then this pin will be able to drop into the next notch, since it will enter towards the latter underneath the pawl. When the pin drops back into the notch, the prong, *e*, is ready to engage in the projection, *c*, of the balance wheel, B, which it does when the balance has swung nearly to the limit of its angular movement, so that when disengaged, the balance is ready to start off in full action immediately.

We see then that the momentary depression of *p* will start the clockwork; and as there are three notches in *w*, the movement will go on until *w* has turned through a third of a complete revolution; or as *w* turns once in a minute, the clockwork will run for one third of a minute before it stops.

Fixed on the axis of *w* is a light hand, *n*; this hand in a complete revolution makes contact with metallic projections, k_1, k_2, and k_3, successively; the projections are fixed on a metal ring, which can be turned through any desired angle by means of the pointer, *h* (fig. 3). It is evident therefore that the period which will elapse before the hand, *n*, makes contact with any one of the projections will depend upon the position of the pointer, *h*; if the pointer is set at division 1, for example, then on the clockwork being started contact will be made by the hand, *n*, almost immediately; but if the pointer be set at division 7, then a longer period will elapse before the contact occurs. The hand, *n*, being in connection, through the wheelwork, with the lever, *l*, and the ring, R, being in contact, through the flexible connection, *t*, with the push, *p*, it is evident that the result of the contact will be to send a current out to line. The depression of the push, *p*, in fact, sends a momentary current out to line, which current will be followed after a certain interval, which is adjustable, by a second momentary current. The possible angular movement which can be given to the ring, R, is less than one-third of a complete circle, whilst the hand, *n*, is so fixed on the arbour of *w* that when the pointer, *p*, stands at division 1 (the left hand limit of its movement) this hand is a little behind one of the projections on the ring, R. It follows from this that no matter what be the position of the pointer, *h*, the hand, *n*, after touching a projection, will always advance beyond it before stopping.

Referring now to fig. 5 let us suppose that the first current has been received from the central station, then this current comes from, say, the Up line, passes through the electro-magnet, M, and from thence through the switch lever, S^w, and the key, *k*, to the Down line. The electro-magnet being excited pulls up the lever, *a*, and the end of the latter disengages from the balance-wheel, B, and allows the clockwork mechanism in connection with B to run. Attached to the lever, *a*, is a toggle, *t*, which tends to move to the left under the influence of the spring, *s*. As soon as the lever, *a*, is lifted up, the projecting piece on this toggle hitches over the stop, *e*, being drawn over it by the spring, *s*, so that when once attracted, the lever, *a*, is unable to fall back to its normal position and stop the balance, B, the clockwork, therefore, will continue to run. The end of the toggle, *t*, it will be seen, touches against the right hand side of an arm, c_1, which arm is fixed to the axis of the wheel, *w*; now the length of the end of the toggle is such that if the latter is just hitched on the stop, *e*, this end would not quite clear the arm, c_1; if however the toggle is raised a little higher, then the end will clear, and as *t* is pulled to the left by the spring, *s*, it follows that when *t* is lowered until its projection banks on the stop, *e*, the end of *t* will come down on the *left* hand side of c_1, so that *w* can revolve without obstruction. The limiting stops of the lever, *a*,

are so adjusted that the movements referred to can take place as indicated.

Let us, then, suppose that the lever, *a*, has been raised and released again so that the toggle, *t*, has become raised over the end of c_1, and let down on the left hand side of the latter, and that *t* has become hitched on to *e*, so that the balance-wheel, B, is free to move and the clockwork mechanism to turn, then the wheel, *w*, which revolves once in a minute like the wheel, *w*, in fig. 4, rotates until the arm, c_2, comes round in contact with the end of the toggle; the latter is then pushed off its stop, *e*, and allows the lever, *a*, to fall and lock the balance, B.

Now the arm, *g*, which is also fixed to the axis of *w*, in the course of its rotation comes in contact with the spring, S, and if it should happen at that particular moment that a second current is sent through the line, then this current will divide, part passing through M, and actuating the lever, *a* (this movement, however, effecting no change in the condition of affairs), whilst the other half of the current (dotted arrows) passes through the magnet, *m*, of the Bell, and by releasing its mechanism causes it to sound. If however the current should come either *before* or *after* the arm has made contact with the spring, then this current cannot pass through the Bell.

Now we have seen that the interval of time which elapses between the transmission of a current by the depression of the stud, *p* (figs. 1, 3, and 4), and the transmission of a second current by the arm, *n* (fig. 4), can be regulated by the pointer, *h* (fig. 3), if therefore the contact springs, S, on the instruments of subscribers 1, 2, 3, 4, 5, 6, and 7, are so arranged that when the mechanisms of all the instruments are set going the first contact is made in instrument 1, the second contact in instrument 2, the third in instrument 3, and so on; and further, if the positions of the springs are so adjusted that the interval of time intervening between two successive contacts is the same in every case, then it is evident that if the pointer, *h* (fig. 3), be set at, say, division 5, then the contact made by the arm, *n* (fig. 4), will be made at the same time that contact is made by the spring, S, on the instrument of subscriber 5.

Attached to the wheel, *w* (fig. 5), is an indicating disc, w_1 (*see* figure at side). This disc is divided into twelve divisions, six white and six red. This disc is set behind the aperture W_1, seen in fig. 6, which has openings cut in it, so that when the disc makes a twelfth of a revolution the red spaces disappear, and the white take their place, or *vice versâ*.

In the position of the apparatus shown in fig. 5, the white portions of the disc appear (showing that the line is clear), and the same will be the case if the arm, c_4, or arm, c_5, be touching the toggle, *t*. If, however, either arm, c_2, c_3, or c_6, be against *t*, then the red portions will be exhibited (showing that the line is occupied).

It has been explained that when a subscriber calls the central exchange station he depresses his call button, *k*, fig. 5, and sends a current. The effect of this is to cause the lever, *a*, fig. 5, in each instrument on the circuit to be attracted, and to set the clockwork mechanisms in action. When arm, c_2, comes round, it unhitches the toggle, *t*, off the stop, *e*, on which it has been lifted and stops the train of clockwork; consequently the red of the discs in each instrument will be exhibited, showing that the line is occupied. As the dropping of the indicator at the central station has disconnected the circuit, no second current can be sent by any subscriber, and consequently the discs being once set at "line occupied," cannot be changed to "line clear," by any one but the central exchange.

Supposing now that the apparatus at the central office is connected to line 1, the pointer set at the number of the subscriber it is required to call, and the push, *p*, depressed, then a momentary current flows out to line, which sets the mechanisms of all the instruments on the circuit in motion, and, as has been explained, causes the bell of the required subscriber to sound; when the mechanism has come to rest, one of the arms, c_3, c_6, or c_2, of the wheel, *w*, in each instrument will be against the toggle, *t*, and consequently the discs will show "line occupied."

After the allotted time for the subscribers to communicate has expired, the apparatus, fig. 3, at the exchange station is conducted to line 1, as was explained at the beginning of the article, and the button, *b*, depressed once, so as to send a momentary current to line; this causes the levers as in each subscriber's instrument to be attracted, and the mechanisms to be released; but these are almost immediately stopped by the second arm, c_4, c_5, or c_1, in each instrument unhitching the toggles; the small angular movements of the discs change their indicators to "line clear." The apparatus, fig. 3, is then connected to line 2, and the same operation is gone through.

The "clearing" current, it will be observed, could be sent equally well by depressing the stud, *p*, instead of the button, *b*; but inasmuch as the apparatus could not be transferred from line 1 for use on line 2 until the clockwork mechanism set free has come to rest, it is preferable to employ the button, *b*.

It will be understood that the switch arrangement, S", shown in fig. 5, has attached to it other connections for bringing the usual telephone transmitting battery, transmitter, and induction coil into circuit, but these connections have been left out in the figure to avoid confusion in the important parts of the illustration. These connections being purely local, in no way affect the action of the indicating apparatus.

From the explanations which have been given it must be evident that the invention of Mr. Kettell possesses amongst other advantages one very important one, and that is that the apparatus is self-adjusting. If by any chance it should happen that a signal should fail from a fault in the line wire or from any other reason, the instruments do not require any resetting; this is not the case with other inventions which have been brought out for similar purposes. The mechanism is not at all liable to derangement and does not require heavy battery power to work it, the function of the latter being merely to release the wound-up mechanism, and not to drive it.

The number of revolutions which the wheels, *w*, *w* (figs. 4 and 5), would have to make in a day is so very small that the mechanism would run for a very lengthened period without requiring to be wound up. In the case of the alarum bell this winding up would have to be done more often, but as there is a small indicator ("Wind" fig. 6) connected to the work which shows when the rewinding is required the wheel-inconvenience of the clockwork running down and the bell ceasing to act is not likely to arise.

NEW ELECTRIC LIGHT COMPANIES.

WE notice in the daily press of the present week the advertisement of a new electric light company, and a preliminary notice pending the formation of another. These are respectively the "J. B. Rogers electric light and power," and the "Electric Sun lamp and power" companies. Up to the present we have not considered the electric inventions of Mr. J. B. Rogers of sufficient importance to occupy much space in our columns, and we have only referred on one or two occasions to the various reports which have appeared in certain journals relating to them. Now that a company has been formed for working the numerous patents, English, foreign and colonial, of Mr. Rogers, we purpose making a few remarks in the interests of both electrical engineers and the public. The prospectus, after stating for what purpose the company is promoted, and making a point of its being a parent company, goes on to say,

> The subdivision of the electric current has hitherto been the great desideratum, and the fact that Mr. Rogers obtained the first patent for a system of sub-division, dated 20th September, 1880, which is prior to any other patent for this specific purpose, shows that he was one of the earliest workers in this direction.

This so-called subdivision of the *electric current*, we need scarcely say, has been known as long as the current itself, which is therefore some years before Mr. Rogers began his scientific investigations on the subject of electric lighting. Now, if such a patent could be called valid, why, then, Mr. Werdermann stands some time before the Rogers patent of 1880. The matter contained in this specification, of what we will call out of courtesy an invention, was brought prominently forward by *Iron* on several occasions, and some of the daily newspapers also spoke very highly of the system. It would hardly be fair on our part to stigmatise this portion of what the J. B. Rogers vendors are promoting

as we at first felt disposed, because Mr. Rogers himself, the vendors, *Iron*, and the rest *may* actually believe that there is something in it, and that the patentees' copper globes are really other than "multiple binding screws." We, however, solemnly and sincerely declare our belief that the magic properties of these metallic globes or cups exist only in the imagination of those we have quoted, and that a very near approach to the results of Mr. Rogers has been obtained by Messrs. Edison, Swan, Lane-Fox, &c., independently of such aid.

It may be, however, that we are wrong, for we notice our monthly electrical contemporary gravely states the following :—

> Put broadly, the system amounts to this: Mr. Rogers charges—we must not use the word accumulates or stores—the electricity into certain vessels, something like a large ball-cock of a cistern, and literally taps them to supply practically any number of incandescent lamps. Incidentally it is only fair to Mr. Rogers to say that, having some knowledge of, and respect for, the English tongue, he uses the word "accumulates" purely in the sense of "gathering together," and not in the sense of "storing," as understood and used by modern electricians.

We must, even in the face of this authority, still hold our own opinion, based on the hardly gained experience of many, many years, that an installation of the electric light on the Rogers system might be rendered somewhat less costly and less liable to derangement outside a laboratory or office, were the dividing boxes left out of the question.

We do, however, believe that Mr. Rogers has in action a very good incandescent lamp, but what claims are set forth in the patent for this we cannot say, as we believe the specification has not yet been published. In the schedule attached to the prospectus there are nine different patents, including the one we have just referred to for *division* and *subdivision*. As far as we are aware the patents for incandescent lamps, accumulating and storing electricity, and dynamo-electric machines, have only been applied for since the beginning of February of the present year; it is, therefore, impossible for us to comment on five out of the remaining eight. That the public is prone to look upon anything for which a small sum is asked as worthless is well known, the price, however, required by the vendors of these patents, which, according to the prospectus, go to make up a complete system of electric lighting, is £40,000 in cash, 12,000 fully paid-up shares of £5 each, and 2,000 deferred shares of £5 each, the capital of the company being £510,000 in 100,000 preferred shares and 2,000 deferred shares of £5 each respectively. We may incidentally remark that, besides the patent of 1880 mentioned in the prospectus, there are now published the following specifications of Mr. Roger's electrical inventions: Nos. 1922, 4854, and 4855, this last having for its object the production of the *arc* and *incandescent* light in the *same lamp* and by the *same carbons* at will, so that the light may be changed from one to the other by a simple movement.

Seriously we do not desire to say anything respecting this company of a harsh nature, for it may be that Mr. Rogers really believes he has discovered actual improvements in electrical science; but from what we have seen and heard for ourselves we could not in justice to electricians with *bonâ fide* inventions, or to the investing public, recommend a system of so-called division and subdivision concerning which the most ridiculous and misleading statements, it has ever been our lot to notice, have been noised abroad.

The second company to which we have called attention is apparently following the example set by the Fyfe-Main arc lamp promoters. Perhaps the result will be the same, but for the future gain of electric lighting we hope not, as so simple and inexpensive a lamp as the "Sun" deserves to make headway.

THE RED SEA CABLE.—We understand that Messrs. Siemens Brothers & Co. have chartered for the laying of that cable the ss. *Rochefort*, belonging to Messrs. John Cory & Co., of Cardiff. The *Rochefort* is a screw steamer, 220 ft. long by 31·2 ft. beam by 15·6 ft. deep, of 874 tons gross, and 99 horse-power. She is now moored off Messrs. Siemens Charlton, where she is being fitted with the necessary machinery, &c., for this kind of work.

INFLUENCE OF ELECTRIC CURRENTS UPON EACH OTHER.

WE think that very little information is ever to be found on this subject beyond that in certain text books, mostly belonging to a bygone age. As it is a question of considerable importance to electrical engineers, and as it can now be studied with much stronger currents than have heretofore been possible, we propose to occasionally devote a portion of our columns to the purpose of bringing the matter before electricians engaged in the practical work of electric lighting, believing that they may be able to materially augment our present knowledge by experiments of their own. The discovery made by Œrsted that *an electric current transmitted near to a magnetic needle deflected it from its normal position* excited throughout the scientific world the liveliest interest. New facts were experimentally sought for in order to prove the identity of electricity and magnetism, or to show that they were both only different examples of the same fundamental force. Electrical engineers now have opportunities for studying these effects in a

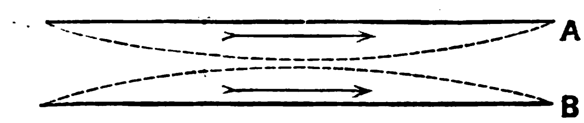


FIG. 1.

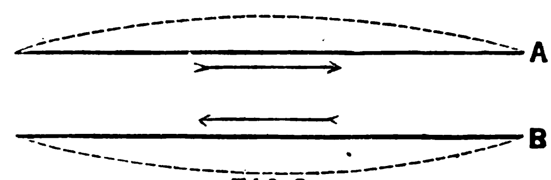
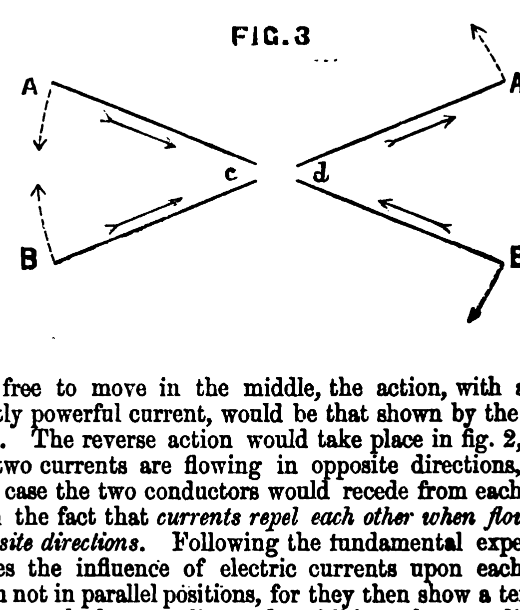


FIG. 2.

manner, and with means beyond anything available in the days of Œrsted and Ampère. It is well known that the latter philosopher found that the influence of electric currents on each other varied with position and direction, and the following is the fundamental law according to which these different influences act :—*Parallel currents attract each other when they flow in the same direction.* In fig. 1, A and B represent two conductors in which currents are flowing in the same direction, as indicated by the arrows. Were these conductors free to move in any direction, they would close up together, or if they were fixed at two points

FIG. 3



and free to move in the middle, the action, with a sufficiently powerful current, would be that shown by the dotted lines. The reverse action would take place in fig. 2, where the two currents are flowing in opposite directions, for in this case the two conductors would recede from each other, from the fact that *currents repel each other when flowing in opposite directions.* Following the fundamental experiment comes the influence of electric currents upon each other when not in parallel positions, for they then show a tendency to approach the same line and to fall into the same direction on that line.

If we take two currents, A *c*, B *c* (fig. 3), both flowing towards *c*, and forming whatever angle, the tendency will

be for the two conductors, from the example given in fig. 1, to approach each other, as shown by the dotted lines. This attraction would of course take place if the two currents were flowing from *c*, instead of towards it; repulsion takes place when one current is going in the direction *d* A, and the second in the opposite way, B *d*. We are feign to believe that now we are able to produce such powerful currents by means of dynamo-electric machines, some of our electrical engineers will devise a means of still further simplifying the lamps used in electric lighting by the aid of the attraction and repulsion of electric currents. At present we can call to mind but one practical application of this force, viz., the candle of M. Jamin. This well-known French *savant* took advantage of the fundamental law before mentioned to keep the electric arc at the tips of the parallel carbon pencils forming his candle; but some time before M. Jamin's invention, Mr. Robert Sabine had devised and taken out a provisional specification for electric lamps, in which the attraction and repulsion of currents were made, not only to keep the electric arc at the ends of two parallel rods of carbons, but these were also arranged in such a manner in connection with thick copper conductors, that the repellant force of the currents used was of sufficient strength to part the carbons automatically, and the distance between the carbons varied as the intensity of the current. We well remember assisting at the experimental trials of three different forms of electric lamps devised by Mr. Sabine and based on this principle, the results of which were at least encouraging, although the facilities for working at that time were not so great as at present. Perhaps another reason why these experiments were dropped was the fact that they were somewhat in advance of the times, there being little demand for, or encouragement to invention in electric lighting. We have brought the matter forward in the hope that it may suggest ideas to the many inventive minds now centred on perfecting this most useful of modern necessities.

MESSRS. SIEMENS AND HALSKE'S SELENIUM PHOTOMETER.

MEASURING instruments have always played an important part in electrical researches. The rapid progress of this new science, bringing into notice every day the discovery of phenomena hitherto unobserved, has in fact necessitated all throughout, methods of measurement better adapted to the nature and importance of the effects observed. Thus, these instruments were neither the least numerous nor the least interesting among the various models shown at the International Exhibition of Electricity. As marvels of invention, and the greater number at least as masterpieces of delicacy of construction, they justly ranked high in that great scientific and industrial display; but they derived their importance chiefly from the necessity of checking incessantly the results obtained, thus confirming one by the other the great laws which govern electrical phenomena throughout.

This apparatus, which is merely mentioned among M. J. Reynaud's notes, appended to his translation of Gordon's "Experimental Treatise on Electricity and Magnetism," is based on the variations of the electrical resistance of selenium under the influence of light. Among the very remarkable, but as yet illdefined, electrical properties of selenium, there is one which is known to everybody, viz., the diminution of its resistance under the influence of light. When subjected to different radiations, selenium does not seem to be influenced by the rays of heat, whereas the maximum of the effect produced upon its resistance seems to correspond to the maximum of light (between yellow and green). From this it follows that a comparison of the intensities of any two sources of light, based upon the variations of resistance in this substance, can only be exact when lights of the same colour are compared. This condition is expressly stated by the inventors of the selenium photometer, who have endeavoured to utilise this curious property as far as possible in the ingenious apparatus of which we are now going to give the description and the method of using.

DESCRIPTION.

The instrument consists essentially of two distinct parts: a galvonometer and the photometer properly so called.

Galvanometer.—The galvanometer is a Thomson portable galvanometer, G, fig. 1, with a single coil, in the middle of which a tube of copper, containing the mirror, slides easily. This mirror, concave in form, very light, and furnished with little magnets which distinguish it, is suspended in the tube by the top and bottom, by means of very short fibres; a little glass cap closes the tube in front of the mirror, and a screw placed at the back of the tube enables the mirror to be held fixed for packing or to be left free to swing; its oscillations can besides be slackened and thus the instrument is made into a dead beat galvanometer. A magnet, N, fig. 1, enables the influence of the terrestrial magnetism to be withdrawn, and thus the sensibility of the apparatus is made to vary.

This galvanometer is mounted on the same stand as a petroleum lamp, L, protected by an inclosure of sheet iron. Opposite to an opening in front of the inclosure and with a

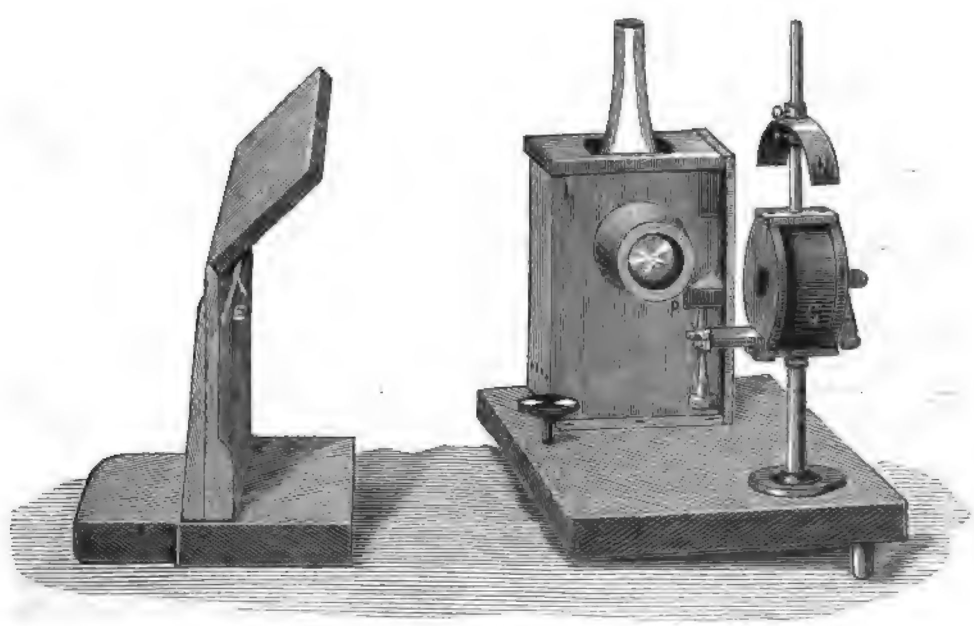


FIG. 1.

vertical cross wire between is placed a lens, which collects into a luminous sheaf the rays sent out by the lamp. The galvanometer and the lamp are arranged at right angles to one another on the stand. A prism, with total reflection, P, is placed over the galvanometer and supported by a stand which allows of it being adjusted to the position required. The luminous beam sent out by the lamp is received on the prism and sent back by it on to the mirror, which in its turn reflects it on to a divided scale, E, which is independent of the galvanometer and which can be drawn back or brought nearer at will in order to obtain clearness in the reflections.

In order that the prism with total reflection may not intercept the ray reflected by the mirror when the deviation is somewhat considerable, it must be placed a little lower than the mirror, and the reflecting surface must have the inclination required in order that the light reflected at first on the upper part of the prism may then fall on the mirror and pass on its return a little above the reflecting prism.

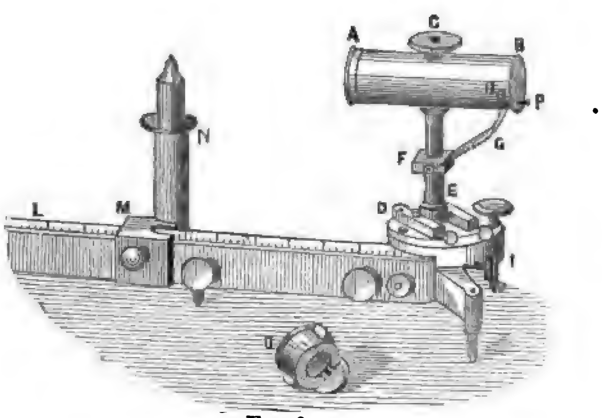


FIG. 2.

Photometer.—The photometer properly so called (fig. 2) consists of the selenium tube and of a graduated rule along which the luminous source taken as standard can move. The selenium tube is a tube of copper, A, B, 0^m. 03 in diameter and about 0^m. 15 long, blackened inside and mounted perpendicularly on a support movable round its vertical axis. This support is terminated at the bottom by a circular base, furnished with three horizontal branches with feet, which serve to keep firm the apparatus; of these three feet one, I, is screwed and allows of the position of the system being regulated.

On the circular base of the support are placed two horizontal terminals, D, E, insulated from the rest of the apparatus and only in communication with a circular metallic socket in the middle of which the support turns. In the latter is fixed a little plate of ebonite, F, with a metallic cincture, to which are fixed two contact springs, which insure electrical communication with the socket and the lower terminals in every position of the support.

The copper tube, A, B, open at both ends, can receive at one of its extremities, A, a metallic cap with a circular diaphragm, and at the other extremity, B, either a cap containing a screen with a cross wire, or the selenium box shown at O at the bottom of the diagram. This selenium box is made of horn and slides easily into the opening, B, of the cylinder. It contains the plate of prepared selenium sheltered from the light by a little slide, which is opened or closed at will on the apparatus by a little button shown at P. It is besides furnished with two little terminals, H, connected to the plate of selenium and insulated from the rest of the system; two insulated wires, G, coiled in a spiral, put these terminals, H, in contact with the two springs, and the lower terminals in all the positions of the tube, A, B, which is moved by the top button, C.

From this description it follows that a battery current arriving by one of the terminals, D or E, will pass through one of the contact springs, one of the wires, G, and one of the terminals, H, to the plate of selenium, and will return by the corresponding course to the other terminal, E or D, following, besides, all the movements of the tube, A, B.

On one of the horizontal branches of the tripod is fixed a scale, also horizontal, one metre in length, the zero of which is in the vertical plane passing through the selenium plate. Along this divided scale slides a runner, M, bearing the candlestick in which is placed the standard light. This light is maintained fixed at the height of the axis of the tube, A, B; its axis is in the vertical plane passing through the joint where the reading is taken, which allows its distance from the plate of selenium to be measured exactly.

We can, also, by means of the screw shown near I, in the foot of the apparatus, limit at will the course of the tube A, B, in the horizontal plane, and bring it without difficulty into such a position that the standard light may be in the prolongation of its axis.

MODE OF EMPLOYMENT.

Installation of the Galvanometer.—The scale is placed beyond the direct action of the lamp, and in such a manner that the middle of it may be about in the direction and at the height of the axis of the galvanometer, at a distance of at least 0^m. 5 from it (fig. 3).

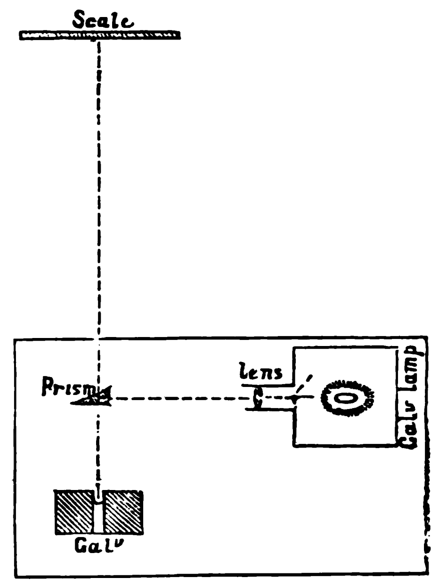


FIG. 3.

Into the coil of the galvanometer is introduced the copper tube containing the mirror with magnets, and it is adjusted in such a manner that the suspending fibres of the mirror which serve as an axis of oscillation may be about vertical.

The plane of the flattened flame of the petroleum lamp is made to coincide with that passing through the network and the centre of the lens (fig. 3). In order to arrive at it, we begin by taking away the prism appended to the galvanometer, so that the luminous ray of the lamp may fall freely on a sheet of white paper placed at a distance of one to three metres, so that by a suitable displacement of the lens a shadow of the wire may be obtained. The lamp is made to slide until the shadow of the wire no longer presents chromatic edges.

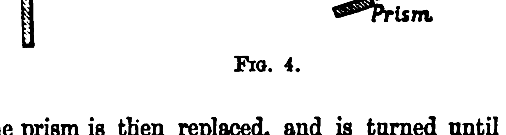


FIG. 4.

The prism is then replaced, and is turned until the reflected ray falls on the mirror with magnets, which is ascertained by looking directly at the mirror. The course of the reflected ray is then followed by the mirror, by means of a sheet of paper on which the ray is let to fall, and the prism is fixed in such a position that the light reflected by it falls in the middle of the mirror, and that the ray sent back by the latter passes back directly above the prism (fig. 4). By turning the screw, V, which is shown on the stand of the galvanometer (fig. 1), the ray is then brought to the height of the scale, and by causing the position of the directing magnet surmounting the galvanometer to vary,

it is made to arrive at any required division of the scale. Finally, the lens is made to slide until the shadow of the wire reflected on the lens is quite clear, and the tube of copper containing the mirror is turned until the shadow moves horizontally along the scale.

By raising or lowering the directing magnet, we increase or decrease at will the sensibility of the galvanometer, which can besides be arranged in any plane whatever.

In the lantern, for the objective in which the wire is stretched, we can substitute another, forming a diaphragm in which a vertical slit is made.

Employment of the Photometer.

The selenium photometer is adjusted in such a manner that the movable tube, when it is perpendicular to the scale, may be directed towards the luminous source, the intensity

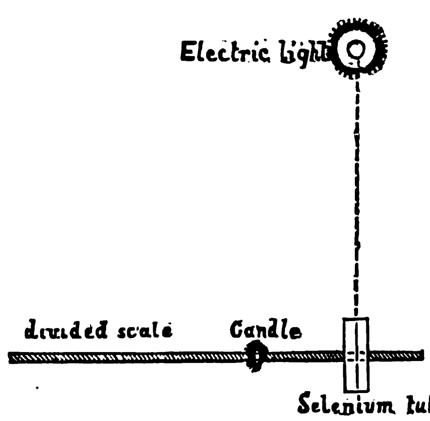


FIG. 5.

of which is to be measured (fig. 5). In order to arrive at this, the horn box containing the plate of selenium is taken away, and for it is substituted the socket, transparent at the bottom, with a cross wire, the front part of the tube being closed also by the diaphragm with the hole in the centre. The photometer is then turned in the direction of the luminous source until the shadow of the hole is projected on to the middle of the cross. Then the two abovenamed caps are taken away and the one at B is replaced by the selenium box.

These operations having been performed, we connect in one circuit the galvanometer, the plate of selenium, and a battery of 12 or 24 elements, which is filled with acidulated water, but not put into action until the moment for its employment.

As soon as the circuit is closed, a deviation of the galvanometer is observed, and the spot of light often goes off the scale; by adjusting the directing magnet, the reflection is brought back within the limits of the scale.

Under the action of the light, the resistance of the selenium decreases, and consequently the deviation of the galvanometer produced by the current increases. The plate of selenium is exposed to the light by the open portion of the tube which is turned towards the luminous source to be measured, and by the opening of the little valve of the selenium box adjusted at the other end of the tube.

We observe the deviation of the mirror corresponding to the resistance of the selenium influenced by the light; then, by causing the selenium tube to make exactly a quarter of a revolution—regulated by the screw, I (fig. 4)—it is directed towards the standard light, and the slide, M, is made to slide along the divided scale until the same deviation of the luminous point is obtained as before. By directing the selenium towards first one and then the other of the luminous sources, observing the corresponding deviations, and causing the distance of the standard light to vary along the rule, we find the distance at which the two sources of light produce the same effect on the selenium. These variations of resistance are very rapid. The distance of the plate of selenium from the light to be measured being known, and the luminous intensities being in inverse ratio to the squares of the distances, a simple reading of the divided scale enables the relative lighting power of the light studied to be deduced immediately. But, as we said at the commencement of this article, the selenium photometer is only strictly accurate when lights of the same colour are compared.

[This article was written for *La Lumière Electrique*, by M. E. Boistel, who is, we believe, the manager of Messrs. Siemens Brothers' establishment in Paris.]

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

ON the 11st inst., by the kind permission of Brigadier General Sir Evelyn Wood, V.C., G.C.M.G., K.C.B., commanding the Chatham District, and of the Commandant of the School of Military Engineering, Chatham, a reception was held at the latter place by Lieut.-Colonel Webber, R.E., the president of the above society. A large number of guests availed themselves of the invitation. After a luncheon at the Royal Engineers' officers' mess, a short lecture on torpedo warfare was delivered in the theatre by Major ARMSTRONG, R.E. The lecturer explained the various systems of torpedo defence at present in use. The firing of the fuses was either accomplished by low or high tension electricity. In order to make a clear distinction in the apparatus, that which was employed for low tension firing was coloured white; this included the various cases for holding the explosive materials. The apparatus, &c., for high tension firing was all coloured black. By this arrangement the various kinds of stores were not liable to become mixed up accidentally. The cases containing gun-cotton were partially painted red as a distinguishing mark. The nature of gun-cotton was explained by experiment, and it was shown that a form of the cotton which would only burn silently when ignited by the direct action of flame, could be exploded by a detonating fuse. The action of the "contact makers" in floating torpedoes was pointed out and practically illustrated. Major ARMSTRONG, in alluding to the exhibit by the War Department of torpedo apparatus at the Crystal Palace, said that the display might have been much greater if it had not been considered unadvisable to make too public many of the inventions devised.

The guests were next conducted over the schools of electricity, photography, chemistry, architecture, &c., and were also shown the various field operations, such as bridge and earthwork construction, the demolition of railway tracks, the firing of mines, both under water and under ground, the former especially producing a very magnificent effect.

The impression given was that the whole system of practical military instruction was very complete. It is, perhaps, needless to state that the whole party were much pleased with their visit, and with the extreme courtesy they received from the officers of the corps.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

FIRE RISKS FROM THE ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Can you find room for the following sketch of the certain consequences attendant upon the carrying out of the wonderful sections 8 and 9 of the regulations for the prevention of fire risks arising from electric lighting? Of the other sections I can but express my astonishment that such an eminent assemblage of scientific men should have deliberated to so little purpose and produced nothing but commonpla-

phrases. It is evident that not one practical man was asked for an opinion.

Scene, large jeweller's shop in Bond Street; time, afternoon in the month of November, a regular black fog outside, electric lights turned on (fitted up according to the 21st section of the regulations against risk by fire), and very much to the satisfaction of the proprietor, making him feel very safe. Enter lady, stylishly dressed. Shopman, bowing and rubbing his hands, either from custom or cold (the electric light doesn't give out any heat):

"What can I have the pleasure of showing you to-day, m'am?"

Lady: "I should like to see some diamond parures."

Shopman brings out some six cases of magnificent ornaments, and inwardly chuckles that the electric light has "fetched" this customer.

"Magnificent! unrivalled!—worth 4,000 guineas; the Duchess of S—— can't match them."

Sections 8 and 9 take effect. The shopman hears the rustling of a dress, the creaking of a door. The consequences flash across his mind and he rushes round the counter, over a judiciously-placed chair, with his proboscis against a plate-glass case. With the shock the five words—"D— the rules and regulations!"—are jerked out of him. £10,000 are gone! Electric light companies are at a discount, and dear old Gas taken into favour again.

The committee must have slept the last four years. What has been the aim of all electricians? To make the light reliable, and here are rules, framed by clever men, to make what has been accomplished nugatory.

Your leader is sensible and in the right direction; it is a pity the committee couldn't have it before their eyes; we should then have been spared such a poor exhibition.

I remain, Sirs,
Yours obediently,
E. A. PARIS.

Shepherd's Bush, W., *July 8th*, 1882.

A NEW USE FOR INCANDESCENT LAMPS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—It is a well-known fact that in many countries night fishermen use lights to attract the fish towards the nets or other appliances for catching them. To carry this idea out to perfection, our fishermen must have an incandescent lamp (supplied from an accumulator carried in their boats), attached to the nets as they cast them into the water. It is a very common occurrence for one of our fishing boats in Scotland to catch in a single night herrings to the value of one hundred pounds, and I think I am correct in saying that a special committee appointed lately to inquire into fishery matters, agreed from evidence that there were as many fish in the sea now as in the days of our forefathers, so that there seems to be no fear of the supply running short. Would it not, therefore, be wise for some enterprising individual or company to make experiments in this line?

Speaking from some knowledge of both subjects, I believe the idea to be a perfectly practicable one.

I am, yours faithfully,
DENSHIN.

ELECTRIC LIGHTING FOR STREETS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Touching remarks by Col. Haywood on the lighting of the Holborn Viaduct by the Edison Incandescent Light, I would observe that I presume the Colonel likes the lighting because it is very "gas-like," save that the latter has the advantage. I consider the Viaduct far better lighted by gas than by the small electric lamp. The spoiling of walls and furniture does not here apply, and the two being nearly equal in illuminating power, gas is decidedly the best for the purpose; but in the matter of street lighting, we want more light—very much more light. Same applies to railway stations; and I may here mention that since the District Railway at Charing Cross has been lighted by electricity no accidents have occurred; prior to such they were not unfrequent—I allude to passengers stumbling in getting in and out of the train for want of sufficient light.

Over near three years ago the Holborn Viaduct was lighted by the Jablochkoff system. Col. Haywood then pronounced it beautiful, but too expensive. At *that* date it cost 6½d. per light per hour: same price was charged the Metropolitan Board of Works for the Embankment. Excessive cost caused the City authorities to discontinue the light; the Board continued, and, by a gradual reduction, have now arrived at 1½d. per light per hour for a lamp giving 380 candle-power. The street lamp gas-lighted costs ¼d. per hour for 10 candle-power. The calculation is easy.

If the Holborn Viaduct is to be lighted by electricity let it be by an arc lamp, by which much more light will be afforded; not by an electric light which in every feature as nearly as possible resembles gas. We live in an age of improvement, and desire to be further enlightened. By all means let us have Sugg's grand burner, if not too expensive; but do not attempt to light great thoroughfares by an electric lamp which in candle-power is not superior to the ordinary gas-lamp of the past decade.

ELECTRON.

July 11th, 1882.

DOLBEAR TELEPHONE: A CRITICISM CRITICISED.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In a recent number of this journal (June 24th) an article appeared from *La Lumière Electrique*, in which Count du Moncel takes occasion to criticise a paper read March 23rd, 1882, by Prof. A. E. Dolbear, before the Society of Telegraph Engineers.

Prof. Silvanus Thompson has, in the 1st July issue, very ably responded to a part of the statements made by the Count du Moncel, viz., that part relating to the early history of the Reiss telephone. There are also other statements of the Count which it does not seem desirable to have remain unchallenged.

In conclusion he says:—"But I think it is as well to remark that 'Mr.' Dolbear, in calling his apparatus a novelty is in error. In the first place, the production of sounds by a condenser was not new, inasmuch as Mr. Dolbear himself, in his historical account, alludes to it, and what would be new would be the possibility of reproducing speech in this way; but it is Mr. Herz who obtained this result first, at the commencement of the year 1880."

The fact that sounds may be produced by a condenser having been widely known for so long a time, it seems strange that a writer upon scientific subjects should think it necessary to state that the idea is not a new one. As the writer understands the claims of Prof. Dolbear they are as follows:—(*a*.) The first to conceive the possibility of reproducing speech by means of condensers. (*b*.) First to accomplish it by experiments. (*c*.) First to produce a practical speaking telephone founded upon those principles. These claims are still maintained.

In reply to this the Count says, "But it is Mr. Herz who obtained this result (the reproduction of speech) first, *at the commencement of the year* 1880."

This remarkable statement assumes, 1st, that its author is well aware of the time when Prof. Dolbear first accomplished this; and, 2nd, that it was done at a date subsequent to the one above mentioned.

As a matter of fact the Count du Moncel knows nothing of the kind; nor has he ever had any adequate means of knowing.

It behoves the noble Count to be more cautious how he indulges in such unguarded statements. The "impartial historian" does not assume facts and draw conclusions therefrom which suit his own convenience, nor will *such* conclusions ever receive the title of "*legal perorations*."

Granting that the experiments attributed to Mr. Herz were made, as stated, as early as the commencement of the year 1880, the work was not new.

The Dolbear condenser telephone dates are prior to that; indeed the instrument was even then in almost, if not quite, its present perfected shape.

Very many persons had admired its clear and perfect enunciation.

Business men had become interested in it previous to this time and had embarked in the enterprise of bringing it

into public use. Precautions were taken to have ample proof of all this, with signatures and dates upon apparatus with properly certified affidavits, &c., &c.

For the present, for reasons which already appear to have been good and sufficient ones, those dates are withheld. But all the evidence and much more will at the proper time and place be produced. We all know how easy it is to have some abandoned experiment or vague idea recalled by the ultimate success of that idea. To illustrate :—

The Count says—"On June 2nd, 1875, Mr. Bell had thought of this substitution (permanent magnet for electro-magnet), and if this *savant* had not put this into practice in the apparatus exhibited by him at Philadelphia, in June, 1876, it is because he expected to obtain more powerful effects by a system in which the magnetic organisation was formed by an electro-magnet (strongly magnetised by a continuous current) than by a system formed by a simple permanent magnet of steel." Granting, for the time, that Mr. Bell did in June, 1875, conceive the idea that he could use a permanent magnet *in place of a battery*, that idea was, after deliberate reasoning, abandoned by its author as worthless.

This *lost idea* added nothing to the sum of human wisdom. It might as well never have been—indeed better; because it leads to a fixed erroneous opinion. Such opinions, like false theories and formulæ in science, are only productive of evil.

In order that Mr. Bell might recover this idea, one of two things must first happen. Its truth must be forced upon him by accident during his experiments or, having obtained a more complete knowledge of his subject, he must, with the new data, reconstruct his previous opinions. It is generally admitted that abandoned experiments are to be disregarded, because of no use to any one. How much more so an abandoned idea which its author discards. One is reminded of the drowning man and the straw when such claims are woven into what purports to be an historical fabric.

As the second earliest experimenter in this unique line of discovery, Count du Moncel brings forward Mr. Dunand in the following words—"Mr. Dunand, of whom Mr. Dolbear was so careful to speak, in the month of September of the same year, obtained very important results in consequence of principles precisely contrary to those laid down by Mr. Dolbear. Thus, by means of eleven small condensers, formed of sheets of paper of small dimensions and very numerous, joined up in quantity and arranged fan fashion, he succeeded in transmitting speech sufficiently powerfully to be heard at a distance of two or three metres from the instrument. It is true that he employed two batteries, one of which, that destined to polarise the plates, was very powerful; but these experiments show that the theoretical ideas of Mr. Dolbear cannot be accepted without great reserve."

It is not worth while at the present time to discuss the *molecular* and *mass motion* theories for explaining the action of telephonic diaphragms; however, notwithstanding the Count has for years diligently advocated the former, very many, and probably the majority of eminent physicists believe the latter to be the true explanation.

Another of Prof. Dolbear's *theoretical ideas* is as follows:—

"In my opinion the greater the number (of plates) employed the less effective will be the telephone of this kind."

That opinion was the result of long series of experiments many times repeated, and under all conceivable conditions. The Count states, as something astonishing, that speech could be heard *two* or *three metres*, although he admits that the apparatus was somewhat elaborate. Prof. Dolbear says, in that very communication, that he has been enabled to hear speech at a distance of 50 ft. The writer can assure the readers of this journal that the Professor's statement was far within bounds, as could be testified by hundreds who have heard it at that distance. Doubtless Mr. Dunand has done some excellent work in this line; but it is yet to be shown that he is a pioneer in the business.

In referring to the practical use of any telephonic system, even at the present day, Prof. Dolbear took occasion to say that it is necessary to inclose the instrument in a case in order that the air waves might be concentrated upon the ear. Touching upon this point, the Count feels "obliged to say to 'Mr.' Dolbear that there exist telephonic receivers which are susceptible of being heard at a distance!" To one familiar with the immense number of experiments which Prof. Dolbear has performed in this line, with all kinds of, and systems of, apparatus, and in the light of the astonishing results which he has obtained the statement which Count du Moncel feels obliged to make to "Mr." Dolbear is ludicrous in the extreme.

By the way, why is it that the eminent Count, who is generally so courteous, fails to give him his usual title? Prof. Dolbear has for many years occupied a professor's chair in the highest educational institutions in America.

If Count du Moncel will write with a fair and unbiassed pen, the eminent men belonging to the Society of Electrical Engineers, many of whom have ever shown the liveliest interest in original scientific work from every source, will, doubtless, be only too willing to have him eradicate that "complete ignorance" of the host of distinguished *savants* who have occupied themselves in the question of the telephone.

I trust the time will come when Count du Moncel will not display either a "real or voluntary" forgetfulness of the just claims of any one.

HENRY C. BUCK.

NOTES.

TELEPHONE EXCHANGE CALL SYSTEM.—Through the courtesy of Mr. G. Edward Smith, of Boston, Mass., United States of America, we are enabled to give a full description (see p. 24) of a telephone exchange call system, the invention of Mr. Kettell, of Worcester, Mass., U.S.A., which enables a number of subscribers to be put in communication with a central exchange by means of one wire only. The apparatus is considerably in advance of anything of the kind yet brought out, and as we have had an opportunity of seeing it actually in action, we can testify that it can do all that is claimed for it. In view of the extending use of the telephone, the apparatus of Mr. Kettell is one worthy of consideration. As a rule, the number of subscribers that can safely be placed on one circuit is about eight; that is, with the mechanisms of the apparatus arranged so that the wheels, w and w_1, revolve once in a minute. Now, the angles at which the contact arms on the wheel, w, make contact with the spring, s, differ only by a few degrees in each instrument, and as it is important that the contact arms in one instrument be quite clear of the spring, s, before the corresponding arm in the next instrument makes contact in its turn with its own spring, there is a danger of the contact being made in one instrument before contact is broken in the previous one if the angles are made too small; consequently it is not advisable to have too many contacts. If the angles are increased, then the time occupied by the clock-work in passing through the whole series of contacts will be proportionally lengthened, which would cause a delay which is unadvisable. With eight subscribers the clock-work need not run longer than one-third of a minute, and it is not advisable to exceed this time, except in special cases.

If time is of no consequence, there is, of course, almost no limit to the number of subscribers that can be looped on one circuit.

In conclusion, we would state that the invention of Mr. Kettell is certainly the most satisfactory solution of the problem in question which has yet been brought out, and the fact of its being practically used, and with perfect success, is a sufficient proof of its value.

THE TELEPHONE.—We read in the *Electrician* of New York that on the evening of Friday, June 23rd, Professor Dolbear lectured on "The Developments of the Telephone" before the Electrical Society of New York. When in Europe the Professor met the assistant of Reiss, who said that, as a matter of fact, the Reiss telephone actually did transmit words and sentences.

TELEPHONES.—Under this heading the following notice has appeared in several of the Scottish daily newspapers :—

"The Bell Telephones supplied by us to various persons in

Scotland were purchased from the owners of the Bell patents, and the holders of them are requested to disregard the circulars and other communications received from the United Telephone Company (Limited), and to communicate with us—Messrs. Tasker Sons and Company, Sheffield."

THE INDUCTOPHONE.—A letter by C. O. Mailloux appears in the July number of the *Electrician* of New York on the above subject, in which the writer refers to a particular experiment made by him in July and August last, when making observations on the induction balance, which experiment led him to notice all that Mr. Willoughby Smith has recently described.

CANDLE POWER OF ELECTRIC LAMPS.—It would be well to remember in the future that the 2,000 candle power Brush lamp, as employed in the City lighting, is stated to give that amount of light when *naked*, but as covered with a globe this light is reduced 50 per cent., or to 1,000 candles. The Weston lamp, for the same purpose, is stated to give 1,600 candle power naked, and about 1,000 when enclosed, the globe only reducing the light from 30 to 40 per cent. The smaller Siemens lamps, which were stated to give 300 candle-power each, must be understood to mean when enclosed in their globes.

STREET ACCIDENT FROM ELECTRIC LIGHTING.—We notice in the *Times* of the 8th inst. and also in the Brighton papers an account of a peculiar accident which took place at the above town on the evening of the 7th inst. While the members of the local Volunteer Fire Brigade were proceeding up North Road with their fire-escape it came in contact with the electric light wire overhead, and the electric fluid descending the wirework of the escape caused those Volunteers who had control to loose their hold. Another member, thinking the machine was falling, grasped the steering rod, and received the full force of the electricity, which was so powerful as to bend him double, and disable him for upwards of an hour. We are under the impression that the system of electric lighting employed where this accident occurred is that of the "Brush."

ELECTRIC LAMPS FOR LARGE SPACES.—During the earlier stages of the City experiments with the Siemens' large lights they were kept at an altitude of 70 feet above the road and the light enclosed in a globe of clear glass. It was afterwards found that a more advantageous effect was produced by reducing the height above ground to 40 feet and employing opal globes for the lamps.

THE EDISON ELECTRIC LIGHT.—The City Engineer thus speaks of Edison's light in his report to the Commissioners of Sewers :—

"The Holborn Viaduct is at the present time lighted experimentally by the Edison Company, who have placed two incandescent lamps in each gas lantern, each lamp, as stated by the company, giving about the same light as an ordinary gas lamp, and the two, therefore, double the light of the gas lamp disused. No lamp is more than 66 feet distant from another. There is scarcely any part of the Viaduct which is better lighted than another ; there are no strong shadows to deceive the eye and the footstep ; there is no flickering and no material variation in illuminating power, so far as can be noticed by the ordinary observer, and the Viaduct is, for all practical purposes, well lighted.

"This Edison experiment will, when terminated, be specially reported on, and is only referred to here to assist in the consideration of the advantages derivable from the great volume of light given by the arc light compared with that given by the ordinary gas lighting, the incandescent lamps on the Viaduct being arranged on the same principle as the gas lighting, and aiming at uniform distribution of light over the public ways."

THE JEWS AND THE ELECTRIC LIGHT.—A singular difficulty has arisen in regard to Jewish speculation in the electric light. It is asserted that as no orthodox Hebrew will touch fire or light on the Sabbath (a circumstance not generally known), the *Jewish Chronicle* has been asked to decide whether the electric light is unlawful. The editor apparently found himself on the horns of a dilemma, for all he could say was, no orthodox Jewish minister would be prepared to answer the question. If this be so, it may well be presumed that the financial Jew will feel at liberty to use his own discretion.

THE ELECTRIC LIGHT AT LIVERPOOL.—We understand that the Pilsen and Joel Company are now placing the Pilsen arc lamp in Mr. W. Lea's music and pianoforte warehouse at Liverpool.

THE PILSEN ARC LAMP.—We understand that the Pilsen lamps recently fitted up in Messrs. Baker's premises, High Holborn, and also at Messrs. Crisps, of Holloway, are now to be seen nightly in operation.

ELECTRICAL ACCUMULATORS.—We hear that the Hammond Electric Light and Power Supply Company has acquired the right to manufacture and sell Donnithorne's accumulators for the United Kingdom, and that the "Pilsen"-"Joel" Company has also acquired the right to purchase a secondary battery patented by Woodley and Joel.

TELEGRAPHIC INTERRUPTION WITH ALEXANDRIA.—The Eastern Telegraph Company announced on Monday last that their cable ship *Chiltern* had put to sea from Alexandria to pick up the cable, and that all commercial telegrams with Alexandria were stopped. A later telegram, received by the company from their steamer *Chiltern*, stated that she was in communication with Malta and Cyprus, acting under Admiral Seymour's orders.

The Eastern Company have arranged to place a floating station off Suez to keep up communication during hostilities.

THE EASTERN TELEGRAPH COMPANY.—We observe in the *Standard* of last Wednesday the following interesting notes concerning the above company's work at Alexandria. The English public has much reason to be indebted to the Eastern Telegraph Company for the admirable manner in which, under circumstances of the greatest difficulty, the telegraphic service between Alexandria and London has been maintained. It deserves to be mentioned that the telegram which we published in our second edition yesterday morning, announcing the commencement of the bombardment, was despatched from her Majesty's ship *Invincible* at forty minutes past seven a.m., and was received in London at five minutes past six a.m. (the difference in the time between Alexandria and London being as nearly as may be two hours), so that the message reached this office within about thirty-five minutes from the time it was despatched from Alexandria. The verbal accuracy, too, with which the messages are transmitted deserves the highest praise.

At present the Eastern Telegraph Company's ship is moored about four miles from Alexandria, and has on board the cables by which she can communicate with Malta and Cyprus. The land lines in Egypt are now cut, and the Company has moored a large lighter, with their staff on board, three miles from the shore at Suez, from where they can telegraph to Aden and Bombay. Telegrams are coming from Suez round by Bombay and the Indo-European line through Persia, and going round back to the Company's floating station at Alexandria.

An interesting telephonic experiment was tried yesterday at Malta, during the bombardment of the forts at Alexandria. A telephone was attached at Malta to the Alexandria cable, and connection was made with the other end of the cable on board the *Chiltern*, off Alexandria. It was found that, owing either to the distance, or to the vibration caused by the firing, it was impracticable to send a verbal message, but the firing at Alexandria was distinctly heard, through the telephone, at Malta—a distance of more than a thousand miles.

PROTECTING THE TELEGRAPH SHIP "CHILTERN."—After the bombardment of Tuesday, Admiral Sir Beauchamp Seymour, considering the position of the *Chiltern* not altogether secure, gave orders for a vessel to cruise round her for her protection.

THE MULL TELEGRAPH CABLE.—A great deal of inconvenience having been experienced in the island of Mull, owing to the telegraph cable between the mainland and the island being broken, strong representations were made to the Postmaster-General. These representations have not been in vain, as Mr. Fawcett, replying to Lord Colin Campbell, under date July 5th, says :—"I am happy to tell you that the Department has secured the services of a ship to effect repairs to the Mull cable, and that the vessel will be despatched in a few days."

THE AMALGAMATION OF THE ENTIRE TELEGRAPHIC SYSTEM OF CANADA LEGALISED.—From the New York *Journal of the Telegraph* we observe that in the Senate of Canada, at Ottawa, on May 4th, the Act recently passed by the House of Commons legalising the amalgamation of the entire telegraphic system of the Dominion, under the charter of the Great North-Western Telegraph Company, of which Mr. Erastus Wiman, of New York, is president, was passed by a vote of 35 to 11. This consolidation was consummated some time ago, under the auspices of the Western Union Company, which by the privileges now granted to its annex, the Great North-Western Telegraph Company, has secured several substantial and important advantages. The rate in Canada for the past two years under competition has been twenty cents for ten words, irrespective of distance. But this rate has been successfully advanced 20 per cent. to twenty-five cents, and is now legalised in such a manner as to make it almost absolutely permanent. An attempt to make it otherwise, should the profits be exorbitant, was proposed in an amendment, of which the following was the concluding sentence :—"No Act of Parliament reducing the maximum rate herein provided shall be deemed an infringement of the privileges granted by this Act." This amendment was voted down by a large majority, all the members of the Government voting against it, Parliament thus practically affirming the arrangement made with the combined telegraph companies. An amendment to make the rate twenty cents for ten words received an emphatic quietus of 99 to 48, so that in every way the Commons indicated a disposition to give the contracting companies a sufficiently remunerative rate not only to do the work well but also to make some money.

NEW ATLANTIC CABLES.—We hear that the prospectuses are ready for issue of a new company, which is to lay two cables across the Atlantic. These cables are to be manufactured by the Henley's Telegraph Works Company, and when laid the contemplated tariff is to be 9d. per word.

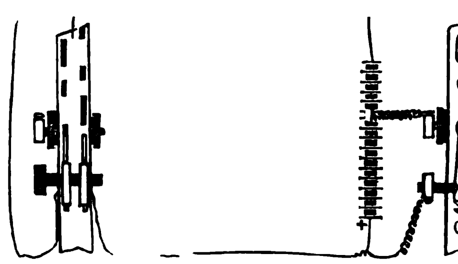
With two fresh cables by the above company, and two, as mentioned last week, to be made and put down by the India-rubber Company, tariffs between England and America should in the future rule low.

CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.—Panama, June 8th.—The W. T. and P. S. S. Company's steamer *Bolivar* brought a number of young men for the service of the Central and South American Telegraph Company on the coast. They are Messrs. Tracey, Pascod, Turner, Harding, Coxen, Cranwell, Rowe, Cooke, Tiddy, Davey, Hoskings, MacLachlan, Barnes, Field, Atherton, and Brain. To only a few of these have stations been assigned, and on the arrival of the *Silvertown*, which may be expected here some time in the present week, Mr. J. B. Stearns, the general manager, now on board that vessel, will arrange the distribution of those now here where the necessities of the service may require. Another contingent sailed from Liverpool by the ss. *Cuban* on the 25th ult., on the arrival of which a distribution of officers, electricians, assistants, &c., will be made from Lima to Tehuantepec. A Mr. Murphy, we are informed, will be the resident agent of the Company in this city, and to Mr. Stanley McNider, now in Guatemala, will be confided the superintendence of the line from this place to Tehuantepec. Per ss. *Dacia* and ss. *Silvertown* the following members of the Central and South American Telegraph Company's staff arrived on the coast :—Messrs. W. Kelly, J. Milne, W. Clarkson, H. F. Horan, M. Murphy, and Charles G. Murphy.

TELEGRAPH STEAMER "INTERNATIONAL."—Since the completion of the Mexican cable extension to Galveston, the ss. *International* has been chartered by the International Ocean Telegraph Company, of New York, to repair one of the Key West-Havana cables, belonging to that company. The India-Rubber, Gutta-Percha, and Telegraph Works Company received on the 4th inst. a telegram from Mr. Theophilus Smith, engineer-in-charge, announcing the safe arrival there on that day of the *International*. All well on board. The *International* will start at once, with these repairs.

AUTOMATIC TELEGRAPH.—Patent No. 259,226, filed in the United States of America Patent Office, November 8th, 1881, by Gerritt Smith :—

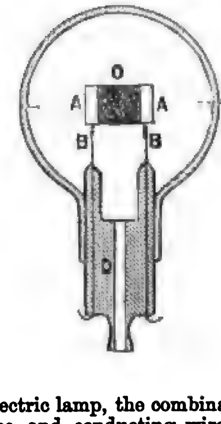
Brief.—When a perforation of the transmitting-strip is under the brush the larger battery is short-circuited, and a record is made at the receiving-station by the right-hand pen. When this short circuit is broken the larger battery overpowers the smaller, and a record is made on the other pen. Any polarised receiving-instrument may be substituted for the pen.



Claim.—The combination, substantially as hereinbefore set forth, of a pattern-strip having a single line of perforations, a circuit-closer brought into action by each perforation in said line in succession, two transmitting-batteries of unequal and contrary electromotive forces, and a receiving-instrument which responds to the action of currents of alternative polarity.

THE ELECTRIC LIGHTING BILL.—It is said that an effort will be made to carry the Electric Lighting Bill through Parliament before the adjournment.

ELECTRIC LAMP.—Patent No. 259,062, filed in the United States of America Patent Office, February 11th, 1882, by Charles J. van Depoele :—



Claim.—1. In an electric lamp, the combination with a confining-globe, a holding device, and conducting-wires, of a non-conducting medium connected with the wires, and provided upon its surface with small particles of finely-divided conducting medium secured close together, but not in electrical contact, substantially as described.

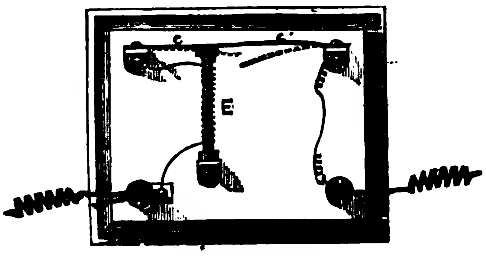
2. In an electric lamp, and in combination with the terminals, A, A, conductors, B, B, a confining globe, and a suitable support, the non-conducting medium, O, provided with small particles of carbon not in electrical contact, substantially as described.

3. In an electric lamp, the combination, with a non-conducting medium provided superficially with small particles of finely-divided conducting material not in electrical contact, of a glass globe enclosing said conducting and non-conducting mediums, and from which the air has been abstracted and replaced by some non-supporting gas, and suitable electrical connections leading from the mediums within the globe, substantially as described.

SAFETY DEVICE FOR ELECTRIC CIRCUITS. — Patent No. 259,616. Filed in the United States of America Patent Office, January 5th, 1882, by Edward Weston.

Brief.—When the paraffin, E, melts from the heat of the resistance it allows the springs, c and c', to separate and break the circuit before damage is done to the instruments in line.

Claim.—1, The combination, with an electric circuit, of a wire or similar conducting medium of higher relative resistance than the conductors with which it is connected, a circuit interrupter, and a mass of fusible material surrounded by or in proximity to the wire of high resistance, and arranged to maintain the continuity of the circuit through the interrupter until softened by heat.



2 In a safety device for electric circuits, the combination, with a circuit interrupter, of a mass of highly fusible material for preventing the same from acting, and a resistance wire included in the circuit with the interrupter, and in proximity to the fusible material, substantially as set forth.

3. In a safety device for electric circuits, the combination of springs, *c*, *c'*, a mass of fusible material for maintaining the same in contact, and a resistance wire surrounding the fusible material, for the purpose set forth.

4. The rod, E, or its equivalent, composed of a non-conducting substance, which softens at a low temperature, and powdered metal for rendering the same a better conductor of heat.

THE INSTITUTION OF CIVIL ENGINEERS.—The Council of the Institution of Civil Engineers, London, have awarded to Mr. Alan Brebner, junior, B. Sc., University of Edinburgh, the Miller Scholarship of £40 yearly for three years, for a paper on "New Forms of Dioptric Apparatus for Electric and other Flashing Lights."

NOTES ON THE LAW AND PRACTICE RELATING TO LETTERS PATENT FOR INVENTIONS.—Our readers will doubtless remember that we published a short time since in the ELECTRICAL REVIEW a series of articles on the above subject by Mr. T. J. Handford. These have now been reprinted by that gentleman with alterations and additions, and the complete pamphlet may now be obtained at his office, 42, Southampton Buildings, Chancery Lane.

ELECTRICAL PATENTS.—During the half year from July to December, 1881, 394 electrical patents were taken out in the United States of America Patent Office. Of these forty-eight are credited to T. A. Edison, and are mostly assigned to the Edison Electric Light Company of New York.

ANOTHER APPLICATION OF ELECTRICITY.—A new electrical instrument, devised by Captain M'Evoy, is likely to be of considerable value in submarine operations, such as searching for torpedoes, sunken vessels, lost anchors, &c., and it may be that submarine telegraph cable work may be aided by its employment. The invention is based on the induction balance of Professor Hughes. The instrument is so arranged that when let down by means of a cable to the bottom of the ocean, the operator, who is listening to a telephone, hears a loud noise when the case containing the apparatus is brought within the influence of the submerged metallic body.

ACCIDENT TO A TELEGRAPH LINEMAN. — A lineman named Thomas Gowrie, in the employment of the North British Railway Company, met with an accident on Saturday last, while repairing a wire at Abbeyhill Station, Edinburgh. When Gowrie was on the top of a pole it broke at the bottom, causing him to fall to the ground, whereby he sustained a fracture of the right thigh.

NEW COMPANY REGISTERED.

J. B. ROGERS ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—Capital, £510,000, divided into 100,000 A or 10 per cent. cumulative preference shares and 2,000 B or deferred shares of £5 each. Objects: To purchase the letters patent of Mr. John Banting Rogers, electrical engineer, of 47, Holborn Viaduct. The consideration is 0 cash, the 2,000 deferred shares and 12,000 prehares, such shares to be considered as fully paid up. The plant, stock-in-trade, and other business property of the vendor will be purchased by the company for £20,000. Signatories: J. T. Lovering, 77, Gresham Street, 1,000 shares; W. G. Rawlinson, 134, Cheapside, 100 shares; T. F. Brooke, 157, Richmond Road, Hackney, 20 shares; T. E. Nicholson, Highgate, 40 shares; C. W. Harris, 14, Golden Lane, 20 shares; J. J. Molyneux, Downs Park Road, Hackney, 20 shares; J. Chapman, 1, Gresham Buildings, 20 shares; B. Newstead, 100, Buckingham Road, Southgate Road, 20 shares; Henry Moore, 59, Bishopsgate Street Within, 100 shares. The signatories elect the first directors; remuneration, £2,000 per annum. Registered 5th inst. by West, King & Adams, 66, Cannon Street.

CITY NOTES.

OLD BROAD STREET.

THE EASTERN TELEGRAPH COMPANY (LIMITED).

THE report states that the company's revenue for the six months ended 31st March, 1882, amounted to £321,810 13s. 5d., from which are deducted £75,140 19s. 5d. for the ordinary expenses and £40,269 13s. 2d. for expenditure relating to repairs of cables during the half-year. After providing £2,585 1s. 4d. for income tax, there remains a balance of £203,814 19s. 6d., to which is added £29,504 9s. 6d. brought from the preceding half-year, making a total of £233,309 1s. From this amount there is deducted £22,726 9s. 2d. for interest on debentures; £20,559 1s. 3d. for dividend to 31st March, 1882, on the preference shares; and £75,000 placed to the general reserve fund; leaving a balance of £115,033 18s. 7d. The directors have, during the half-year, paid an interim dividend of 1¼ per cent. on the ordinary shares for the quarter ending December, 1881. They now recommend the declaration of a final dividend for the year ended 31st March, 1882, of 2s. 6d. per share, and a bonus of 1s. per share, both payable on the 14th instant, making, with the three previous payments on account, a total distribution for the year of 5¼ per cent. on the ordinary shares. The balance of £1,033 18s. 7d., shown at the foot of the revenue account, is proposed to be carried forward to the next half-year. The general reserve fund, after adding the interest received during the half-year, now amounts to £443,535 1s. 7d.; this, with the special reserves stated on the balance sheet, makes the total amount of reserves £490,816 14s. 6d. The revenue includes £19,500 received for the half-year upon the company's shares in the Eastern and South African Telegraph Company. The reserve funds of that company now amount to £118,695 0s. 11d., and, in addition, the sum of £37,537 10s. is held by the trustees of the sinking fund for redemption of debentures. The revenue account also includes £2,600 dividend for the half-year on the shares of the Black Sea Telegraph Company, belonging to this company, by which the line is worked and maintained under agreement.

The various sections of the company's cables are in good working order, with the exception of the direct Lisbon line and the 1870 Aden-Bombay cable. The Lisbon end of the direct cable has been recovered and buoyed, but the operations of the company's ships on the northern end of the line have been delayed owing to the continuance of very rough weather. The repairs to the Aden-Bombay cable have been deferred during the prevalence of the south-west monsoon. Owing to the disturbed state of affairs in Egypt the directors, acting in accord with Her Majesty's Government, have made arrangements to secure telegraphic communication with the fleet at Alexandria in case the connection with the shore should be interrupted. The ss. *Chiltern* has been brought from her station in the Red Sea to Alexandria, and is now there in readiness for further requirements.

A concession has been granted by the Emperor of Austria for the laying of a submarine telegraph cable between Trieste and Corfu. The cable has recently been laid by the Telegraph Construction and Maintenance Company, thus placing Austria, Hungary, and the central part of Europe in direct submarine telegraphic communication with this company's cables in the Mediterranean and Levant. The concession is exclusive for twenty years, and entitles the holders preferentially to the transmission of all official messages and to all private messages not specially directed to be sent by another route. As stated at the last ordinary general meeting, the Board have made arrangements for taking over the line and concession, and a resolution will be submitted to the extraordinary meeting empowering the directors to do so at a price not exceeding £67,000.

The directors have concluded an arrangement with the Turkish Government for the re-establishment of the connection, by telegraph cable, between Malta and the Regency of Tripoli, a distance of 220 miles. The cost will be about £25,000. A resolution will be submitted to the extraordinary meeting approving the arrangement.

On Thursday last the twentieth half-yearly general meeting of the above company was held in the City Terminus Hotel, Cannon Street, John Pender, Esq., M.P., chairman of the company, presiding. There was a large attendance of shareholders.

The Secretary, Mr. George Draper, having read the notice convening the meeting, and the minutes of last meeting having likewise been read and approved, the report was taken as read, after which,

The Chairman said that he should as usual refer to some items in the report, so that they might have a more correct idea of the working of their system during the past six months. Various items of the report were then gone over in detail. He was sorry, he said, that

during the year such a large sum had been necessarily spent for repairs to cables. That expenditure had amounted to £40,269, as against £29,942 for the previous year. He could hardly think that much exception could be taken to expenditure which was preserving their system in such a thoroughly efficient state. The increase of expenditure on salaries and wages (amounting to £5,382) had been owing to increased grants made to the principal clerks and officers of the company, in accordance with a previous resolution that so soon as the traffic reached half a million such increase would be granted. The travelling expenses had also been heavy, owing to the fact that a large number of their staff had now become entitled to leave of absence after periods of five or six years' foreign service. After commenting on other of the subordinate details, the Chairman said that having made those remarks on particular points of the report, he thought he might make a few general remarks which would be interesting to the shareholders. He continued: The first is as to the state of our cables. Well, during the last year we have had more than an ordinary amount of repairs to make, more particularly in the Bay of Biscay. We have had two steamers at work there, and it is, perhaps, the most prolonged repairs we have yet entered upon. But reading as I have, morning after morning, that the ships were obliged to run into harbour on account of the weather, I impute to the rough and continuously bad weather, the cause of the delay incurred in carrying out these repairs. We have received a communication only this morning from the captain of the *John Pender*, which is very satisfactory as far as it goes, though it would have been much more satisfactory had it announced that the cable had been repaired. However, he states that they are in harbour now through stress of weather, "but on the next occasion I propose grappling in 2,500 fathoms of water, over a splendid bottom; and, weather and sea permitting, I have every hope of being able to complete the repairs, as the cable is apparently in good condition." I may tell you that last week they had the cable on board the vessel from 2,154 fathoms of water, but the ship lurched and the cable went over. That was an accident that will occur, but it shows you, gentlemen, that we can really grapple a cable; and a thing is not lost if you know how to find it. Now, gentlemen, I hope any morning now, as we are likely to have finer weather, to hear news that the cable has been repaired. The next remark I have to make is as to the state of our cables in the Red Sea. We had two faults there in the Bombay cable. We have repaired one cable, the other fault we were going on to repair, but it so happened that at that moment the state of affairs in Egypt necessitated the bringing our steamer *Chiltern*, which generally is occupied in repairs of that nature, to Alexandria; and I think that those who are watching the state of affairs in Egypt will observe that the *Chiltern* has done a very great deal of good work (hear, hear). We may congratulate ourselves that without the *Chiltern* you would not have the same amount of news, and the Government would not have been able to guide and direct affairs as they have done, had it not been through the Eastern Telegraph system. The *Chiltern*, I may say, we have placed under the orders of Sir Beauchamp Seymour, the British Admiral, and she is now still doing good work, but I am sorry to say that the state of things in Alexandria has interrupted our system across the isthmus. Yesterday morning that interruption took place; but you need not be alarmed, because, from the foresight of your directors, we entered into a joint-purse arrangement some few years ago with the Indo-European Company that will carry us on till our connection with the East is re-established. I believe that the result of this crisis will be in all probability to give us increased security in our connection with the East. After stating that the Lipari cable was in the most satisfactory condition, Mr. Pender said: There is another point to which I desire to draw attention, that is the Trieste-Corfu cable. We have made such arrangements in connection with that cable as will be brought before you to-day by a resolution, to secure an incorporation of it with our system, which, I may say, is very important for us, looking to the great number of telegraphs which we have got in the Levant, that we should hold any new works of this kind in our own hands. At the extraordinary meeting, therefore, a resolution will be put to you —which I hope you will approve—which will enable us to secure the Trieste-Corfu Egyptian cable for ourselves. There is another concession to which I would also draw attention, and that is the Tripoli concession. That was one of the first cables laid from Malta to Tripoli, and it was laid much upon its own merits. In other words, certain traffic was likely to be secured so as to secure a fair return upon it. That cable was abandoned; it broke; and in those days the company was not rich enough to restore it. Time passed on, and I think one or two figures will justify you in thinking we are right in looking after this Tripoli-Malta concession once more. The exports in 1868 from Tripoli were £105,080; in 1878, they were £477,034; the imports in 1868 were £83,325; in 1878, £355,220. As to the shipping arrivals, in 1868 they were 262; in 1878, 858. The tonnage of arrivals in 1868 being 21,800; in 1878, 105,272. The departures in 1868 were 269; in 1878, 824, the tonnage of which was in 1868, 21,919; in 1878, 149,351 tons. Looking to this trade then, we are now likely to secure a very considerable return upon our outlay. We have been fortunate also in securing from the Porte a renewal of the concession, giving the Malta-Tripoli cable entirely into our own hands. This concession, then, is a very important one, and a resolution in regard to it will be put before you. Now, as to that very important question, the finances of the company, our debentures now are £882,000, partly in six per cents. and partly fives. We think that our property has now taken such a position in the market that we shall be able to float debenture stock at four per cent., so as to enable us to pay off the whole of our present debentures (hear, hear). A special resolution on the subject will also be brought before you, and we are going to ask you to sanction our issuing of debentures at four per cent. It is with a view to take a higher financial position, which, I think, we are fairly entitled to. We have other schemes, I may say, before us, which we may bring before you later. This only I wish you to understand, and it is a question of the progress of telegraphy. Telegraphs, I believe, must be laid to many other countries than those to which they are now laid, especially in our Indian and Colonial Empires. A demand for telegraphs will come, and I simply wish you to understand that this company will not be behind the demand when it does come. The Chairman concluded his speech by moving the adoption of the report, and recommending a declaration of a final dividend for the year ending 31st March last of 2s. 6d. per share and a bonus of 1s. per share, making a total distribution for the year of 5½ per cent. on the ordinary shares.

The Marquis of Tweeddale seconded the motion.

Mr. Stokes, after congratulating the meeting on the very favourable report which had been presented to them, and with the satisfactory progress of their business generally, asked what the Board considered a fair and reasonable sum to put to the reserve fund? It was now nearly half a million, and he would like to know to what figure they wished to carry it.

Mr. Rixon stated that he had only recently returned from the East, and he could assure the meeting that, for good order, management, and respectability, he had found no better class of men anywhere than the servants of the company there. He thought that the Board had earned the thanks both of the commercial future of the community and the public generally for the highly efficient state of their officers and staff.

Mr. Nicolson would like to know the latest information in regard to their interests in Alexandria. He believed that the position of the *Chiltern* at this crisis would show that their directors and their whole staff had had throughout only one thing in view, and that was the interests of Englishmen and of the country at large.

Mr. George Hurst said that their half million of reserve was certainly large, but at the same time he did not think it was so large as they should aim at obtaining. The security and safety of an institution like theirs required something very considerable to fall back upon. They must remember that the capital was 4½ millions, and accidents might occur which would render a large reserve fund indispensable to fall back upon. Their position at the present time was such, that under good management, like that of their existing board, their property was safe and secure as possible; their shares were almost equal to money in the funds, with the advantage of a better dividend. They should do everything in their power to strengthen their position, strong though it was, and if only in the course of a year or two they could get another half per cent. in dividend, nothing would be more satisfactory than the company's position.

Mr. Munro thought that there should be some expression on the part of the meeting of its sense of the efforts made by the staff at Alexandria during the present crisis. Some expression of that sort would encourage their *employés* in their situation in such a post of danger as many of them then occupied. Soldiers and seamen who occupied such positions were made to feel by the notice they attracted that they were really acting a patriotic part; telegraph clerks, while doing their duty in quite as efficient a manner, were perhaps less the objects of observation, and he thought some expression of the satisfaction with which this company regarded the conduct of its staff during the late crisis would be duly appreciated, and would be no more than what the Board might gracefully do (hear, hear).

Mr. Newton asked whether the report was true that one of their principal officers had been slaughtered in the atrocities of the previous day at Alexandria?

The Chairman, in replying to the various questions, said that he could not give a direct answer to Mr. Stokes's query with regard to the maximum of the reserve fund. It was most desirable, looking to their capital, which taking their ordinary shares and their debentures together, amounted to five and a half millions, that they should have a very considerably larger reserve fund than they had at the present time. They had got a very handsome sum, it was true; but when they spoke of half a million, they must speak of the five and a half millions, too, which was spread over 16,000 miles of cables. Consequently, he thought they ought to be satisfied with a comparatively moderate dividend until their reserve was very considerably augmented. It was a very handsome sum they were putting by this year—£75,000—but he had stated at former meetings that they ought to aim at a yearly addition of £100,000. Besides, in increasing their reserve fund, if they did not get their money in dividends they got it in other forms. A stable reserve fund always attracted investments, and so their shares rose in the market. When they were adding £100,000 a-year to their reserve, he should be ready then to support any gentlemen who would then propose an increased dividend for the shareholders. With regard to Mr. Rixon's remarks upon the efficiency of the staff, he believed they were thoroughly well deserved. The First Lord of the Admiralty under the last administration of this country, Mr. W. H. Smith, had told him that he never felt prouder of his country than when, on a visit to the East, he had inspected some of the Eastern Telegraph Company's stations, the tidiness, neatness, and business-like arrangements of the offices, and the smartness of the young men there employed had given him such a high impression of the quality and manner of the work done. He himself (the Chairman) had never been more pleased than when, two days ago, the present First Lord of the Admiralty, who was one of the first men of business not only in the Cabinet but in the country,—he had that old business blood of the Barings in him—had told him the pride he felt as an Englishman at reading of how the *Chiltern* had the other morning picked up a cable and re-established their connection in the short time of two hours. As to another question put, he was sorry to say that they had that morning received a telegram stating that a young fellow—a Frenchman—all honour to him for it!—had stuck to his post in their offices at Alexandria till its destruction took place, and he himself was murdered. It was a painful story to tell, but one of those incidents that all wars carried

in their train. The board would certainly recognise the extraordinary devotion which the staff generally had shown to the interests of the company during the present critical period in the East. Mr. Pender, in concluding his remarks, stated that he believed that the result of the present crisis in the East, would be to secure for England a permanent highway to her Indian and Colonial possessions; and if that were the case they would require a more widely extended system of telegraphic communication.

Mr. Newton asked whether on the Eastern Company's Telegraphic system there was at present any means of communicating between Suez and Port Said?

The Chairman replied that before long a connection between these places would be made on their system. It might have been done before this time, but Government did not always move fast, owing to the routine of a departmental system. He might remark, when speaking of the East, that the Egyptian stock, in which they had invested a good deal of their reserve fund, they had sold at 91⅞ some time ago, though he did not believe that there was any fear of that stock being permanently depreciated. Egypt, no doubt, would pay her dividends; but, as the Board looked forward, they thought they would hardly be justified in retaining the stock which they held in the face of future troubles.

After a few remarks from Lord Alfred Paget as to the efficiency of the staff, which he had observed at Chios,

The Chairman put the resolution for the adoption of the report and the declaration of the dividend to the meeting, and it was carried unanimously.

The Chairman then announced that the next resolution, which had just been drafted, was "That this meeting desires to record its thanks to the staff of the company for their services during the past year, and to declare its high appreciation of the great labour and anxiety which the company's officers have recently undergone, and of the zealous and efficient manner in which they have performed their duties under most trying and difficult circumstances."

The resolution was seconded by Mr. Munro, and carried unanimously.

The Chairman announced that that concluded the business of the ordinary meeting.

Immediately on the close of the ordinary meeting an extraordinary general meeting was held to consider resolutions sanctioning the acquisition by the company of the Trieste-Corfu Telegraph Cable and Concession, and the laying of a cable between Malta and Tripoli, and also authorising the creation and issue of mortgage debenture stock of the company to an amount not exceeding one-third of the paid-up share capital for the time being for redemption of debentures and other purposes, and regulating its transfer and the powers of the company in relation to purchasing and dealing with it.

The Chairman said that the first resolution he had to submit was that the Board be and are hereby authorised to purchase and take over the concession from the Austrian Government, dated August 19th, 1881, referred to in the directors' report, dated July 3rd, 1882, for the establishment of a submarine telegraph cable connecting Trieste and Corfu, and a cable recently laid in pursuance thereof at a total cost not exceeding £67,000.

Sir James Anderson seconded the resolution, which was carried unanimously.

The Chairman said that the next resolution was that the meeting approves of the proposal of the Board to lay a new cable between Malta and Tripoli, as mentioned in the directors' report. He might just say that they had a certain amount of spare cable which they generally kept in reserve, and that they intended to utilise for this Tripoli cable, so that the cost of the whole would be comparatively small, and at the same time they might see from the figures he had given they might expect a very considerable result from the establishment of the line of communication.

The Marquis of Tweeddale seconded the motion, which was carried unanimously.

Mr. Birt, the solicitor to the company, then read a special resolution, which was as follows:—"Resolved (A), That the board of directors be and are authorised from time to time to create and issue mortgage debenture stock of the company to an amount not exceeding one-third of the share-capital of the company for the time being, issued and paid up, upon the terms that the aggregate amount of the said stock for the time being, in issue and the interest thereon shall rank *pari passu* as a first charge on the undertaking and revenue of the company, the stock to be issued at such times and in such amounts, and on such terms and conditions as the Board may from time to time determine; for the purpose of redeeming by exchange or otherwise, the outstanding debentures of the company, and any other purpose to which the capital of this company may be lawfully applicable." "(B). That the Board be and are hereby authorised to make such provision as they may think fit for the registration and transfer of mortgage debenture stock, and for the delivery of certificates thereof, and for the issue of stock warrants to bearer, transferable by delivery, and of interest coupons attached to such certificates or warrants, or otherwise, and for the conversion of warrants to bearer into registered stock, and of registered stock into warrants to bearer, and generally as to the form and incidence of all documents relating to the said stock, so that no holding of such stock be inconsistent with paragraph A of this resolution.

"(C.) That the board be and hereby are authorised from time to time to purchase in the market, hold, and deal with, any amounts of such mortgage debenture stock for the purposes of any reserve fund or investments of the company, and with the sanction of a general meeting to apply other moneys of the company to the purchase in the market of any such stock for cancellation, and with the like sanction afterwards to re-issue mortgage debenture stock in lieu of all or any of the said stock so cancelled, provided all of the amounts of mortgage debenture stock issued and outstanding should exceed the limit prescribed in paragraph (A) of the resolutions."

The resolutions having been put by the Chairman, the Marquis of ... seconded the motion for their adoption.

Mr. Marks said that before these resolutions were carried he should like to know whether they were really necessary. He saw no advantage in issuing bonds at 4 per cent. and purchasing stock at the same rate of interest. The credit of the company was good, and he thought they could pay off these debenture bonds with surplus profits for the year. He could see no benefit at all in the proposed issue.

Mr. W. Griffiths said that the distinction between floating capital and income was so marked that, unless they had a very large income, it was a mistake to lower dividends in order to pay back a certain portion of the capital. He hoped the Board would be supported in their proposal. There was no doubt that the present state of the company was somewhat critical; and they must congratulate themselves that they had a Board which possessed so much energy, fortitude, and foresight. He was very glad indeed when he heard that they had entered into a joint-purse agreement which enabled them to carry on business in the East independent of the political crisis then existing. The resolution read by the solicitor somewhat differed from the terms laid down in the report. The report spoke merely of the debenture stock. He would make a suggestion that it would be wise in the interests of the company generally that they should not confine themselves to debenture stock, but allow any person who wanted debenture bonds to have these instead of stock.

Mr. Birt said that Mr. Griffiths might take it from him that the proposal did not apply to anything but stock and warrants to bearer.

Mr. Griffiths would still press his suggestion. He thought that an option between debenture stock and bonds would be popular with the public, and would conduce to the interest of the company.

Mr. Newton thought the shareholders ought to be congratulated on the fact that it had been determined to issue 4 per cent. stock, though it was somewhat shaking the position of those who had 5 per cent. debentures. It would shake their position, because the Board could then mortgage the property which the holders of the debentures looked to as their security. But the advantages of the issue in other ways would be so great that if it were done their telegraphic property would become a substantially secure investment to investors generally.

Mr. George Hurst would support the views of the directors on the subject. There was one great advantage in having debentures rather than fixed stock, and that was that debentures could from time to time be paid off as a company increased in prosperity; and he did trust that in the course of a few years the debenture stock would be really cleared off as well as their reserve fund greatly increased. He would not mix up the reserve fund with the debenture stock, but keep the former to relieve them in any great emergency. They could not do better than pass the resolution submitted to them.

The Chairman said that they had considered this question most carefully during the last two or three months, and they really did think that the proposed issue was the best course to adopt. If they could float that issue they would be borrowing at 4 per cent. to pay off debentures at 5.

After a few remarks from Mr. Birt in further advocacy of the proposed course, the resolutions were put to the meeting and carried unanimously.

Mr. Newton moved a vote of thanks to the chairman and the board of directors for their efficient management of the said company's affairs, and he did so, though they all knew that he had been a severe critic of the board's procedure from the very commencement of the company.

Mr. Stokes seconded the motion, which was put to the meeting and carried by acclamation.

The Chairman briefly expressed his thanks on behalf of his colleagues and himself, and the proceedings terminated.

INDIAN AND ORIENTAL ELECTRICAL STORAGE AND WORKS COMPANY (LIMITED).

A GENERAL statutory meeting of the above company was held at the Cannon Street Hotel on Tuesday, the 11th inst., Mr. Ernest N..., M.P., in the chair. The secretary, Mr. H. Cleland Heywood, having read the notice convening the meeting,

The Chairman said: Gentlemen, you are aware that by Act of Parliament a company must needs meet within three months of allotment, and therefore this statutory meeting has been called. In an ordinary way I think it is best to say next to nothing on such occasions as these. I will merely say that the allotment of the shares has been made, and we have the pleasure of telling you that all the shares were allotted, and that the applications considerably exceeded the amount registered to be allotted. But what I really wish to say to you to-day is regarding something which has happened since the allotment of shares, something that I believe will be very much to the company's advantage. You have probably heard, or may have seen it in the newspapers, that an arrangement has been made by the Electrical Power Storage Company with the Faure Company ... is concerning this that I have to say a few words. In our prospectus we put forward what we considered a very important question in buying patents—that we had a guarantee from the vendors that our patents would stand. The only real fear we had was as regards any possible infringement of our patents by the Faure accumulator, and therefore we demanded from the Storage Company, who were the vendors, that our patents should stand. We had no doubt as to the superiority of our batteries over those of the Faure accumulator, but we had a fear that those batteries—Sellon-Volckmar batteries—might possibly have some infringement. They were well advised ... there was no infringement, but still, there might be, ... made it a *sine quâ non* that we should have a guarantee ... scientific opinions we had regarding our own batteries ... satisfactory, especially that of Mr. Cromwell Varley ... well known in the electrical world, who, to use his own ... "It is a wonderful battery"; and I believe that the ... out that the Sellon-Volckmar battery is a wonderful ...

was, however, a rival in the field, that of the Faure accumulator. We had no guarantee as to that—as to our company having no rivals. All that the vendors guaranteed was that the patents were valid. Shortly after the allotment we heard that litigation was threatened between the Faure Company and the Electrical Storage Company. After a time we further heard that these two companies preferred peace to war. I am not going into the question as to the arrangement made between these two companies. That is no affair of ours; whether it was wise or unwise is no matter to us. What were the details of that arrangement is really immaterial to us. All that we need to know is that an arrangement was made between these two companies that they should work together; but there was a question which was very important to us. Did this arrangement between the two companies have any effect on our company? Now it came to pass that the Storage Company, who had guaranteed the validity of our patents, had now become the possessors of the Faure patents and the patent rights of the Faure accumulator, as regarded practically the whole world, but at all events—I only speak of the part which belongs to us—of India and the East. This being the case, we felt it incumbent upon us to enter into negotiations with what I may call the parent company. Those negotiations were chiefly carried on through Mr. Sellon, the gentleman whose name stands at the head of our patents—Sellon-Volckmar battery. I assure you that such negotiations were carried on in a manner of great fairness and uprightness. Any one who knows Mr. Sellon, knows that in dealing with him you are dealing with a man not only of remarkable cleverness, not only a great inventor, but a gentleman of remarkably upright and straightforward character, therefore in dealing with him I felt that I was secure in dealing with one who would treat this company fairly. I may say more, that though these negotiations were carried on chiefly through Mr. Sellon himself, the Electrical Storage Company met our company in an extremely honourable and more than conciliating manner. They met us in a way which I can only characterise as wishing to treat us with the favour that a father might treat his eldest son. They had taken great interest in the formation of this company, and they had a full belief in this company, as I will show you in a few moments, and therefore were determined to ascertain to a certain extent what might have been their rights, and to pass over to this company the whole of the patent rights of the Faure Accumulator Company as regards India and our other territories. The terms for which this important concession was given—and I will explain how it was an important concession in a moment—were simply these: As regards the whole amount we were to pay to the Electrical Storage Company it remained the same. The only difference which they demanded of us was a variation to the mode in which the payment was to be made. In the first place, you are aware, as you could see in our prospectus, that we were to pay £25,000 by way of royalty. This royalty might have been spread over some time, it might possibly, if we were not very successful, have been spread over some years. We have, however, now made an arrangement with them that that £25,000 for royalty should be paid within twelve months by instalments. There was another arrangement which you may recollect in our prospectus, that we were to pay £50,000 in shares, with the option of paying it in cash. Most vendors are anxious that they should be paid in cash. I have very rarely heard of a vendor company that was specially desirous of retaining the shares, or having the shares of any subsidiary company given to them, but, as I said just now, the Storage Company think well of us. I think they have reason to, but, at all events, they do think well of us, and they were desirous that they should have part of the option, as regards 5,000 of these shares, or £25,000 taken away, that we should hand over to them that £25,000 in shares without our having the option of paying them in cash. We thought that this was a very fair concession to make, and therefore as regards the option of half the shares we were to transfer to them, we have given it over to them, and they will certainly now be given 5,000 shares, and the remaining 5,000 shares will be given in shares or in cash, as we may elect. Beyond that we have paid nothing for what I shall now in a very few words try to point out are the advantages we have gained from the concessions we have obtained. I may say at once that these concessions would not have been granted to a company differently situated from ourselves. It was only in consideration of the special guarantee they had given us and the consideration that we had so early entered into the field in these negotiations that the Storage Company felt themselves justified in making such very easy terms with us in this manner. But perhaps some one will say, What is the advantage of the Faure patents to us, as you say yours are the better of the two? I do say, and I strongly affirm it, and I believe that the world will know it ere long, that the Sellon-Volckmar as secondary batteries are very much better and far stronger, and therefore are of far more commercial importance, than the Faure; but in saying that I don't want to detract for one moment from the value of the Faure accumulator; and the Faure accumulator having some advantages which the Sellon-Volckmar has not, inasmuch as the Faure accumulator is known, I may say, almost throughout the world, whereas, however much it may be known hereafter, the Sellon-Volckmar battery is at the present moment not known, though we hope it very soon will be; therefore there is that great advantage that we are now possessors of a patent so well known and so highly thought of as the Faure accumulator. There is also another great advantage, an advantage that is not to be lightly estimated by us, and that is the advantage that we get rid of what at present appears, and I believe I may say appears almost positively, the only litigation we could have entered into as regards any one attacking us. We may have eventually to enter into litigation to protect our patents from being pirated; but as regards any attack [illegible] having become the possessors of the patent rights of the [illegible]umulator we have got rid of all litigation. There is something further than that. We have also got rid in India, at all events for a time, of what would have been a rival. We have [illegible]ion of the sole accumulators that are commercially [illegible] am not prepared to say in the present state of electrical science that there may not be in the future some better mode of storing electricity than by our battery, all I can say is this, that at present there is none known, and as far as we can see there is not one likely to be discovered for some time to come that will not be an infringement of our patents. For some time, therefore, we certainly have a monopoly of what are perhaps the most important rights that there can be in the present condition of electrical knowledge. There is something else. In addition to all this, and I think this alone would show that we have obtained in these patents something of real value to our company, it enables us to manufacture our batteries at somewhat less cost. I cannot go into the details of that, and you must merely take it from me, but I have it on good authority that the manufacture of our Sellon-Volckmar batteries, which are the ones we shall continue to hold and use, may be somewhat improved, but will certainly be somewhat cheapened in the production; and that is so much clear profit to us in future. I cannot say what may be the future of electrical science, I cannot say what may be the future of either the use of electricity, or the means of storing electricity, but I can say this, and I think we may congratulate ourselves on it, that already it has been proved that the storage of electricity is a great advance in the progress of mankind in enabling us to lay hold of some of the powers of Nature, which up to this time we had not been able to lay hold of. As just one illustration I may say that we are at this moment engaged in negotiations—I may say negotiations are very nearly completed, and I trust to get a telegram very soon to say that they are completed—by which we shall be the possessors of the natural forces of a waterfall in one of our territories, and the horse-power in that waterfall will be at once transmuted into two things. One will be the lighting of a town, which will be done by a company that is ready to give us orders for batteries for that purpose, and the other will be the motive power in carrying out some important Government works in its neighbourhood. This is only just an illustration of what is in store for us. Our field is great. I believe there is no company except in our own country that will rank higher than our own as to the territories we possess. I believe there is an opening in India both for electric lighting and the use of electricity as a motive power that is not surpassed in any other country in the world.

Therefore, I think, we can look forward as perfectly knowing the difficulties we have got to encounter, difficulties from the inexperience of our electrical engineers, difficulties of all sorts that must be encountered when a new power, as it were, is brought under the dominion of man, and is being wrought as a commercial undertaking. But taking the most sober view of all these difficulties, we are quite prepared to encounter them. I think I may say with confidence that there is a very bright future for this company. There was just one point that I omitted to say anything on in speaking of the terms of becoming the possessors of the patent rights of M. Faure, and that was this—that of course the Electric Storage Company is now required to give a guarantee. We forego that guarantee then given us, because our board considers that we have really secured something far better than the guarantee, those patent rights which alone might have endangered our patents. I do not think there is any other question that I need touch upon to-day. I hope when we meet next year that I shall not have to do so—in fact I feel confident when I have the honour of addressing you then—not to speak of what we hope to do and what we may do, but of what we have done, and I think I look forward with very considerable hope to be able to say something that will be very gratifying to the shareholders of this company. I will just ask Lord Crawford, one of our directors, who is well known in the electrical and scientific world, to say a few words as regards the batteries themselves, which may be interesting to the shareholders.

Lord Crawford said: It would be very difficult to say anything on the subject of batteries without actually going into a long scientific exposition of their method of construction and use, because your chairman has already laid before you in detail the use of these batteries and the methods how they may be used. Without actually going into the practical mechanical differences between the Sellon-Volckmar and the Faure accumulator, I think, unless I were to do so, there is very little left for me to say. I am sure Mr. Noel has gone most carefully into the whole matter, and has told you exactly what is the state of the company's work. There is one thing which is practically self-evident to any one who studies electric lighting, or has anything to do with electricity, and that is the absolute necessity that there should be the means of producing electricity at a certain given time, and so putting the electricity away or storing it until such moments as you may desire to use it (hear, hear). But some means of doing this there must be. I speak not of the electric lighting of docks or of the streets, but for domestic use, or in places which could not be characterised as large places. Under such circumstances it is practically and commercially impossible to have the domestic lighting of rooms, &c., under proper control without having these storage cells whereby during the day you may put away your electricity and use it at any moment you like. I have no doubt that these storage cells, or Faure accumulator, is the only practical way of doing that. When, a few years ago, the Faure cell made a very great sensation—a sensation, I may say, throughout the world, a sensation which set busy brains at work, and clever men—Mr. Sellon produced a battery which many people say is superior to the Faure. I do not wish to go into the merits of the two, because we are practically friendly. But certainly, whether or not the Sellon is an improvement on the Faure, the Faure accumulator was the only rival that the Sellon had in the field when the arrangement was made between them. There have been batteries called storage batteries by number. You can store by decomposing water and letting it recompose itself again. You have then a force laid by, though with no great energy in it; and another thing, it is too costly to produce. The question then of these batteries, or rather, of the position of our company, is that we hold now the Sellon battery, which we may call No. 1, and we

in their train. The board would certainly recognise the extraordinary devotion which the staff generally had shown to the interests of the company during the present critical period in the East. Mr. Pender, in concluding his remarks, stated that he believed that the result of the present crisis in the East, would be to secure for England a permanent highway to her Indian and Colonial possessions; and if that were the case they would require a more widely extended system of telegraphic communication.

Mr. Newton asked whether on the Eastern Company's Telegraphic system there was at present any means of communicating between Suez and Port Said?

The Chairman replied that before long a connection between these places would be made on their system. It might have been done before this time, but Government did not always move fast, owing to the routine of a departmental system. He might remark, when speaking of the East, that the Egyptian stock, in which they had invested a good deal of their reserve fund, they had sold at 91½ some time ago, though he did not believe that there was any fear of that stock being permanently depreciated. Egypt, no doubt, would pay her dividends; but, as the Board looked forward, they thought they would hardly be justified in retaining the stock which they held in the face of future troubles.

After a few remarks from Lord Alfred Paget as to the efficiency of the staff, which he had observed at Chios,

The Chairman put the resolution for the adoption of the report and the declaration of the dividend to the meeting, and it was carried unanimously.

The Chairman then announced that the next resolution, which had just been drafted, was "That this meeting desires to record its thanks to the staff of the company for their services during the past year, and to declare its high appreciation of the great labour and anxiety which the company's officers have recently undergone, and of the zealous and efficient manner in which they have performed their duties under most trying and difficult circumstances."

The resolution was seconded by Mr. Munro, and carried unanimously.

The Chairman announced that that concluded the business of the ordinary meeting.

Immediately on the close of the ordinary meeting an extraordinary general meeting was held to consider resolutions sanctioning the acquisition by the company of the Trieste-Corfu Telegraph Cable and Concession, and the laying of a cable between Malta and Tripoli, and also authorising the creation and issue of mortgage debenture stock of the company to an amount not exceeding one-third of the paid-up share capital for the time being for redemption of debentures and other purposes, and regulating its transfer and the powers of the company in relation to purchasing and dealing with it.

The Chairman said that the first resolution he had to submit was that the Board be and are hereby authorised to purchase and take over the concession from the Austrian Government, dated August 19th, 1881, referred to in the directors' report, dated July 3rd, 1882, for the establishment of a submarine telegraph cable connecting Trieste and Corfu, and a cable recently laid in pursuance thereof at a total cost not exceeding £67,000.

Sir James Anderson seconded the resolution, which was carried unanimously.

The Chairman said that the next resolution was that the meeting approves of the proposal of the Board to lay a new cable between Malta and Tripoli, as mentioned in the directors' report. He might just say that they had a certain amount of spare cable which they generally kept in reserve, and that they intended to utilise for this Tripoli cable, so that the cost of the whole would be comparatively small, and at the same time they might see from the figures he had given they might expect a very considerable result from the establishment of the line of communication.

The Marquis of Tweeddale seconded the motion, which was carried unanimously.

Mr. Birt, the solicitor to the company, then read a special resolution, which was as follows:—"Resolved (A), That the board of directors be and are authorised from time to time to create and issue mortgage debenture stock of the company to an amount not exceeding one-third of the share-capital of the company for the time being, issued and paid up, upon the terms that the aggregate amount of the said stock for the time being, in issue and the interest thereon shall rank *pari passu* as a first charge on the undertaking and revenue of the company, the stock to be issued at such times and in such amounts, and on such terms and conditions as the Board may from time to time determine; for the purpose of redeeming by exchange or otherwise, the outstanding debentures of the company, and any other purpose to which the capital of this company may be lawfully applicable." "(B). That the Board be and are hereby authorised to make such provision as they may think fit for the registration and transfer of mortgage debenture stock, and for the delivery of certificates thereof, and for the issue of stock warrants to bearer, transferable by delivery, and of interest coupons attached to such certificates or warrants, or otherwise, and for the conversion of warrants to bearer into registered stock, and of registered stock into warrants to bearer, and generally as to the form and incidence of all documents relating to the said stock, so that no holding of such stock be inconsistent with paragraph A of this resolution.

"(C.) That the board be and hereby are authorised from time to time to purchase in the market, hold, and deal with, any amounts of such mortgage debenture stock for the purposes of any reserve fund or investments of the company, and with the sanction of a general meeting to apply other moneys of the company to the purchase in the market of any such stock for cancellation, and with the like sanction afterwards to re-issue mortgage debenture stock in lieu of all or any of the said stock so cancelled, provided all of the amounts of mortgage debenture stock issued and outstanding should never exceed the limit prescribed in paragraph (A) of the resolutions." The resolutions having been put by the Chairman, the Marquis of Tweeddale seconded the motion for their adoption.

Mr. Marks said that before these resolutions were carried he should like to know whether they were really necessary. He saw no advantage in issuing bonds at 4 per cent. and purchasing stock at the same rate of interest. The credit of the company was good, and he thought they could pay off these debenture bonds with surplus profits for the year. He could see no benefit at all in the proposed issue.

Mr. W. Griffiths said that the distinction between floating capital and income was so marked that, unless they had a very large income, it was a mistake to lower dividends in order to pay back a certain portion of the capital. He hoped the Board would be supported in their proposal. There was no doubt that the present state of the company was somewhat critical; and they must congratulate themselves that they had a Board which possessed so much energy, fortitude, and foresight. He was very glad indeed when he heard that they had entered into a joint-purse agreement which enabled them to carry on business in the East independent of the political crisis then existing. The resolution read by the solicitor somewhat differed from the terms laid down in the report. The report spoke merely of the debenture stock. He would make a suggestion that it would be wise in the interests of the company generally that they should not confine themselves to debenture stock, but allow any person who wanted debenture bonds to have these instead of stock.

Mr. Birt said that Mr. Griffiths might take it from him that the proposal did not apply to anything but stock and warrants to bearer.

Mr. Griffiths would still press his suggestion. He thought that an option between debenture stock and bonds would be popular with the public, and would conduce to the interest of the company.

Mr. Newton thought the shareholders ought to be congratulated on the fact that it had been determined to issue 4 per cent. stock, though it was somewhat shaking the position of those who had 5 per cent. debentures. It would shake their position, because the Board could then mortgage the property which the holders of these debentures looked to as their security. But the advantages of that issue in other ways would be so great that if it were done their telegraphic property would become a substantially secure investment to investors generally.

Mr. George Hurst would support the views of the directors on the subject. There was one great advantage in having debenture rather than fixed stock, and that was that debentures could from time to time be paid off as a company increased in prosperity; and he did trust that in the course of a few years the debenture stock would be really cleared off as well as their reserve fund greatly increased. He would not mix up the reserve fund with the debenture stock, but keep the former to relieve them in any great emergency. They could not do better than pass the resolution submitted to them.

The Chairman said that they had considered this question most carefully during the last two or three months, and they really did think that the proposed issue was the best course to adopt. If they could float that issue they would be borrowing at 4 per cent. to pay off debentures at 5.

After a few remarks from Mr. Birt in further advocacy of the proposed course, the resolutions were put to the meeting and carried unanimously.

Mr. Newton moved a vote of thanks to the chairman and the board of directors for their efficient management of the said company's affairs, and he did so, though they all knew that he had been a severe critic of the board's procedure from the very commencement of the company.

Mr. Stokes seconded the motion, which was put to the meeting and carried by acclamation.

The Chairman briefly expressed his thanks on behalf of his colleagues and himself, and the proceedings terminated.

INDIAN AND ORIENTAL ELECTRICAL STORAGE AND WORKS COMPANY (LIMITED).

A GENERAL statutory meeting of the above company was held at the Cannon Street Hotel on Tuesday, the 11th inst., Mr. Ernest Noel, M.P., in the chair. The secretary, Mr. H. Cleland Heywood, having read the notice convening the meeting,

The Chairman said: Gentlemen, you are aware that by Act of Parliament a company must needs meet within three months of its allotment, and therefore this statutory meeting has been called. In an ordinary way I think it is best to say next to nothing on such occasions as these. I will merely say that the allotment of the shares has been made, and we have the pleasure of telling you that all the shares were allotted, and that the applications considerably exceeded the amount registered to be allotted. But what I really wish to say to you to-day is regarding something which has happened since the allotment of shares, something that I believe will be very much to the company's advantage. You have probably heard, or may have seen it in the newspapers, that an arrangement has been made by the Electrical Power Storage Company with the Faure Company. It is concerning this that I have to say a few words. In our prospectus we put forward what we considered a very important question in buying patents—that we had a guarantee from the vendors that our patents would stand. The only real fear we had was as regards any possible infringement of our patents by the Faure accumulator, and therefore we demanded from the Storage Company, who were the vendors, that our patents should stand. We had no doubt as to the superiority of our batteries over those of the Faure accumulator, but we had a fear that those batteries—Sellon-Volckmar batteries—might possibly have some infringement. They were well advised that there was no infringement, but still, there might be, and we made it a *sine quâ non* that we should have a guarantee. The scientific opinions we had regarding our own batteries were very satisfactory, especially that of Mr. Cromwell Varley, a name well known in the electrical world, who, to use his own words, said, "It is a wonderful battery"; and I believe that the world will find out that the Sellon-Volckmar battery is a wonderful battery. There

was, however, a rival in the field, that of the Faure accumulator. We had no guarantee as to that—as to our company having no rivals. All that the vendors guaranteed was that the patents were valid. Shortly after the allotment we heard that litigation was threatened between the Faure Company and the Electrical Storage Company. After a time we further heard that these two companies preferred peace to war. I am not going into the question as to the arrangement made between these two companies. That is no affair of ours; whether it was wise or unwise is no matter to us. What were the details of that arrangement is really immaterial to us. All that we need to know is that an arrangement was made between these two companies that they should work together; but there was a question which was very important to us. Did this arrangement between the two companies have any effect on our company? Now it came to pass that the Storage Company, who had guaranteed the validity of our patents, had now become the possessors of the Faure patents and the patent rights of the Faure accumulator, as regarded practically the whole world, but at all events—I only speak of the part which belongs to us—of India and the East. This being the case, we felt it incumbent upon us to enter into negotiations with what I may call the parent company. Those negotiations were chiefly carried on through Mr. Sellon, the gentleman whose name stands at the head of our patents—Sellon-Volckmar battery. I assure you that such negotiations were carried on in a manner of great fairness and uprightness. Any one who knows Mr. Sellon, knows that in dealing with him you are dealing with a man not only of remarkable cleverness, not only a great inventor, but a gentleman of remarkably upright and straightforward character, therefore in dealing with him I felt that I was secure in dealing with one who would treat this company fairly. I may say more, that though these negotiations were carried on chiefly through Mr. Sellon himself, the Electrical Storage Company met our company in an extremely honourable and more than conciliating manner. They met us in a way which I can only characterise as wishing to treat us with the favour that a father might treat his eldest son. They had taken great interest in the formation of this company, and they had a full belief in this company, as I will show you in a few moments, and therefore were determined to ascertain to a certain extent what might have been their rights, and to pass over to this company the whole of the patent rights of the Faure Accumulator Company as regards India and our other territories. The terms for which this important concession was given—and I will explain how it was an important concession in a moment—were simply these: As regards the whole amount we were to pay to the Electrical Storage Company it remained the same. The only difference which they demanded of us was a variation to the mode in which the payment was to be made. In the first place, you are aware, as you could see in our prospectus, that we were to pay £25,000 by way of royalty. This royalty might have been spread over some time, it might possibly, if we were not very successful, have been spread over some years. We have, however, now made an arrangement with them that that £25,000 for royalty should be paid within twelve months by instalments. There was another arrangement which you may recollect in our prospectus, that we were to pay £50,000 in shares, with the option of paying it in cash. Most vendors are anxious that they should be paid in cash. I have very rarely heard of a vendor company that was specially desirous of retaining the shares, or having the shares of any subsidiary company given to them, but, as I said just now, the Storage Company think well of us. I think they have reason to, but, at all events, they do think well of us, and they were desirous that they should have part of the option, as regards 5,000 of these shares, or £25,000 taken away, that we should hand over to them that £25,000 in shares without our having the option of paying them in cash. We thought that this was a very fair concession to make, and therefore as regards the option of half the shares we were to transfer to them, we have given it over to them, and they will certainly now be given 5,000 shares, and the remaining 5,000 shares will be given in shares or in cash, as we may elect. Beyond that we have paid nothing for what I shall now in a very few words try to point out are the advantages we have gained from the concessions we have obtained. I may say at once that these concessions would not have been granted to a company differently situated from ourselves. It was only in consideration of the special guarantee they had given us and the consideration that we had so early entered into the field in these negotiations that the Storage Company felt themselves justified in making such very easy terms with us in this manner. But perhaps some one will say, What is the advantage of the Faure patents to us, as you say yours are the better of the two? I do say, and I strongly affirm it, and I believe that the world will know it ere long, that the Sellon-Volckmar as secondary batteries are very much better and far stronger, and therefore are of far more commercial importance, than the Faure; but in saying that I don't want to detract for one moment from the value of the Faure accumulator; and the Faure accumulator having some advantages which the Sellon-Volckmar has not, inasmuch as the Faure accumulator is known, I may say, almost throughout the world, whereas, however much it may be known hereafter, the Sellon-Volckmar battery is at the present moment not known, though we hope it very soon will be; therefore there is that great advantage that we are now possessors of a patent so well known and so highly thought of as the Faure accumulator. There is also another great advantage, an advantage that is not to be lightly estimated by us, and that is the advantage that we get rid of what at present appears, and I believe I may say appears almost positively, the only litigation we could have entered into as regards any one attacking us. We may have eventually to enter into litigation to prevent our patents from being pirated; but as regards any attack on us, by having become the possessors of the patent rights of the Faure accumulator we have got rid of all litigation. There is something still further than that. We have also got rid in India, at all events for a time, of what would have been a rival. We have now possession of the sole accumulators that are commercially of value. I am not prepared to say in the present state of electrical science that there may not be in the future some better mode of storing electricity than by our battery, all I can say is this, that at present there is none known, and as far as we can see there is not one likely to be discovered for some time to come that will not be an infringement of our patents. For some time, therefore, we certainly have a monopoly of what are perhaps the most important rights that there can be in the present condition of electrical knowledge. There is something else. In addition to all this, and I think this alone would show that we have obtained in these patents something of real value to our company, it enables us to manufacture our batteries at somewhat less cost. I cannot go into the details of that, and you must merely take it from me, but I have it on good authority that the manufacture of our Sellon-Volckmar batteries, which are the ones we shall continue to hold and use, may be somewhat improved, but will certainly be somewhat cheapened in the production; and that is so much clear profit to us in future. I cannot say what may be the future of electrical science, I cannot say what may be the future of either the use of electricity, or the means of storing electricity, but I can say this, and I think we may congratulate ourselves on it, that already it has been proved that the storage of electricity is a great advance in the progress of mankind in enabling us to lay hold of some of the powers of Nature, which up to this time we had not been able to lay hold of. 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Therefore, I think, we can look forward as perfectly knowing the difficulties we have got to encounter, difficulties from the inexperience of our electrical engineers, difficulties of all sorts that must be encountered when a new power, as it were, is brought under the dominion of man, and is being wrought as a commercial undertaking. But taking the most sober view of all these difficulties, we are quite prepared to encounter them. I think I may say with confidence that there is a very bright future for this company. There was just one point that I omitted to say anything on in speaking of the terms of becoming the possessors of the patent rights of M. Faure, and that was this—that of course the Electric Storage Company is now required to give a guarantee. We forego that guarantee then given us, because our board considers that we have really secured something far better than the guarantee, those patent rights which alone might have endangered our patents. I do not think there is any other question that I need touch upon to-day. I hope when we meet next year that I shall not have to do so—in fact I feel confident when I have the honour of addressing you then—not to speak of what we hope to do and what we may do, but of what we have done, and I think I look forward with very considerable hope to be able to say something that will be very gratifying to the shareholders of this company. I will just ask Lord Crawford, one of our directors, who is well known in the electrical and scientific world, to say a few words as regards the batteries themselves, which may be interesting to the shareholders.

Lord Crawford said: It would be very difficult to say anything on the subject of batteries without actually going into a long scientific exposition of their method of construction and use, because your chairman has already laid before you in detail the use of these batteries and the methods how they may be used. Without actually going into the practical mechanical differences between the Sellon-Volckmar and the Faure accumulator, I think, unless I were to do so, there is very little left for me to say. I am sure Mr. Noel has gone most carefully into the whole matter, and has told you exactly what is the state of the company's work. There is one thing which is practically self-evident to any one who studies electric lighting, or has anything to do with electricity, and that is the absolute necessity that there should be the means of producing electricity at a certain given time, and so putting the electricity away or storing it until such moments as you may desire to use it (hear, hear). But some means of doing this there must be. I speak not of the electric lighting of docks or of the streets, but for domestic use, or in places which could not be characterised as large places. Under such circumstances it is practically and commercially impossible to have the domestic lighting of rooms, &c., under proper control without having these storage cells whereby during the day you may put away your electricity and use it at any moment you like. I have no doubt that these storage cells, or Faure accumulator, is the only practical way of doing that. When, a few years ago, the Faure cell made a very great sensation—a sensation, I may say, throughout the world, a sensation which set busy brains at work, and clever men—Mr. Sellon produced a battery which many people say is superior to the Faure. I do not wish to go into the merits of the two, because we are practically friendly. But certainly, whether or not the Sellon is an improvement on the Faure, the Faure accumulator was the only rival that the Sellon had in the field when the arrangement was made between them. There have been batteries called storage batteries by number. You can store by decomposing water and letting it recompose itself again. You have then a force laid by, though with no great energy in it; and another thing, it is too costly to produce. The question then of these batteries, or rather, of the position of our company, is that we hold now the Sellon battery, which we may call No. 1, and we

also hold the Faure, which we may also call No. 1 with a star. I do not wish to draw any distinction between them. Especially when they are amalgamated, we have no reason to fear any danger of their being improved upon. The great difficulty of improving upon the Sellon battery is that so far as I recollect it will reproduce about 90 per cent. of the amount of energy you put into it. Giving out that amount, any person who wishes to improve upon it has only really 10 per cent. to improve upon, and that is very small indeed when you come to think of the difficulty of improving on a battery which actually does return 90 per cent. Further, I have been informed that the Sellon battery has never yet been asked to perform all that it can do. I do not think, Mr. Chairman, that I need delay the meeting any further.

The Chairman said: If any shareholder wants to ask any questions I shall be happy to answer them, though the present meeting is not like the next one, when many questions as regards our working will come up. I may say that we are commencing our work this week—at least I hope the first batteries will be delivered this week; they will certainly be tested this week, or at the beginning of next. We have purchasers for these batteries, and for as many as we are likely to obtain for the next few months. Before that time is over I have no doubt we shall have many more purchasers; and I can only anticipate that we shall not stay in want of those who so urgently demand what we have to supply. I am glad that Lord Crawford brought it out that incandescent lighting—I may be wrong, but I hold it very strongly—is simply an impossibility for domestic purposes without storage. I am connected with a company that is anxious to produce the incandescent light, and that company has stopped its incandescent lighting till it could obtain its storage batteries, because it was felt that it was unsatisfactory to have any light that you could not use just as you could use gas, as much or as little as you like, so that you have got your supply at hand, and have no fear of sudden extinction, or of the house being left in the dark by the failure of your engine or other apparatus. In fact, I think it must be self-evident to anybody who thinks of it, that storage is essential to a really effective mode of lighting our houses.

Mr. Boyd said that they had been told the effective resultant of the Sellon-Volckmar battery was 90 per cent. Could the chairman tell them what the effective strength of the Faure accumulator was?

The Chairman said he should not like to give an opinion on the Faure. Their own opinion had been that the Sellon was better, but they had not yet had the Faure batteries at work. He had often conversed with scientific men on that subject, and he himself had seen the Faure at work at Paris; but he felt that it was not just to those who thought highly of the Faure accumulator to give an opinion on the subject. He had no doubt that at their next meeting their experience would enable them to speak with some approach to certainty.

A vote of thanks to the chairman was then unanimously carried on the motion of Mr. Adamson, seconded by Mr. Kerkpatrick, and this having been briefly acknowledged, the proceedings terminated.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.

ACCORDING to the report to be presented at the meeting to be held on the 19th instant, it appears that the gross receipts for the half-year ended June 30th last, including the balance brought from last account, amount to £21,279 7s. 11d., and the gross expenditure to £5,782 9s. 11d., leaving a sum of £15,496 18s. to the credit of revenue account. Of this, the sum of £3,950 has been placed to the reserve fund, increasing that fund to £47,000. After providing for the preference dividend, a balance of £8,546 18s. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, free of income-tax, which will absorb £6,400, and leave £2,146 18s. to be carried forward to the current half-year's account. The directors have pleasure in reporting that the cables have continued in good working order. In the matter of the suit instituted against the Spanish Government at Havana for a return of the tax erroneously levied on the Havana-Santiago business, which was decided by the court there in favour of the company, and the decision appealed against to Madrid, appearance has been entered on behalf of the company, and the case is now on the list of the Section of the Contencioso in the High Council of State waiting to be heard. The date of the trial has not yet, however, been fixed. At the recent extraordinary meeting to fill up the vacancy in the office of auditor, caused by the death of Mr. Cowan, several shareholders remarked upon the inconvenience of having to call a special meeting in such cases, and suggested the expediency of altering the articles of association so as to provide against similar contingencies. The directors, in order to meet these views have, with the notice of the ordinary meeting, sent out a further notice of a special resolution, which will enable the shareholders, if they think fit, after the termination of the ordinary business, to effect a slight alteration in the articles to meet the case. The director who retires from the Board at this time is Mr. Alexander F. Low, who, being eligible, offers himself for re-election. Mr. Thomas Greenwood, the auditor who was elected at the extraordinary general meeting in May, in place of the late Mr. Cowan, also retires and offers himself for re-election.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).—Notice has been given, that an extraordinary general meeting of the Anglo-American Brush Electric Light Corporation (Limited) will be held at the Cannon Street Hotel, London, E.C., on Tuesday, the 18th day of July, 1882, at two o'clock in the afternoon, when the subjoined resolution will be proposed. Should such resolution be passed by the required majority it will be submitted for confirmation to a second extraordinary meeting which will be [illegible]tly convened. Proposed resolution: "That the 85th of the Association be repealed, and that in lieu thereof the following be henceforth the 85th of such articles: '85. The directors may from time to time of their own authority pay to the members in proportion to the amounts paid up, or credited as paid up, on the shares held by them respectively, such bonus and such interim dividends as in the judgment of the directors the position of the corporation justifies.'"

THE CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY.—An interim dividend has been declared, at the rate of 10 per cent. per annum for the three months ending the 30th ult.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—An interim dividend has been declared of 12s. per share to all shareholders on the register on the 10th instant.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. July 12.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	24⅜- 25⅜	25⅜ ac.
		Do. Do.	10	47 - 52	
150,000	1	Electric Light and Power Generator Co.	1	½- ⅝	11/16 ½ ac.
25,000	5	Great Western Electric Light & Power Co.	2½	1 - 1½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	11½-12½	11¾m. 11¾ ⅞ ½. 12¼ ⅛ 12 ac.
40,000	5	Indian & Oriental Electrical Storage Works	2	1¾- 2¼	2¼ ac.
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1¾- 2¼	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	50- 51	50½ .50m. 50½ ⅜ ½ ac.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	80 -81	80 m. 80½ 80 ac.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19½- 20½	20½ ⅜ ¼ ac
130,000	10	Brazilian Submarine, Limited	10	11½- 11¾	11*.⅝ ac.
16,000	10	Cuba, Limited	10	9½- 10½	9¾ m.
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 6¾	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11⅝- 11⅞	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10½- 10⅝	10½ 9/16 ⅝ ac.
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11 - 11½	11¼ ac
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	12⅝ ac.
125,000	10	Great Northern	10	12½- 12¾	12 9/16 m.
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26 - 27	
100,000	100	Do. 6 per cent. Debentures, 1883	100	101 -105	
17,000	25	Indo-European, Limited	25	28 - 29	28¾ ac.
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	2 - 2½	
8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	265 -275	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	100 -105	
37,350	12	Telegraph Construction and Maintenance	12	29 - 30	29¾m. 29¾ac.
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures			
69,910	20	Western and Brazilian, Limited	20	7 - 7½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	107 -112	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	99 -102	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	8 - 8½	
4,669	10	Do. 6 do. 2nd do.	10	6½- 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1¾	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	1	¾- 1	
100,000	5	United Telephone Co.*	5	11½-12½	11¾ ⅞ ⅞ 12 11¾ ac.

* Exceptional amount at special price.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of June was 3,022, estimated to produce £2,900, against 2,757 messages, producing £2,837, in the corresponding month of last year. The traffic receipts for the months of March and April estimated at £4,000 and £3,800, realised £4,123 and £3,921.

The Brazilian Submarine Telegraph Company. The traffic receipts for the week ending June 10th were £3,547, against £3,072 in the corresponding period of last year.

The Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of June, 1882, are £1,983, as against £1,456 in the corresponding period of last year.

The Eastern Telegraph Company. The receipts for the month of June were £46,450, against £40,074 last year.

The Eastern Extension Telegraph Company. The receipts for the month of June were £31,122, against £29,339.

Great Northern Telegraph Company. The traffic receipts in June, 1882, were £22,560 from the 1st January to 30th June, 1882, £115,560, and for corresponding months of 1881, £114,966, and 1880, £108,035.

West Coast of America Telegraph Company. The receipts for two months ending May were £6,100, against £5,050 in the same period last year.

Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending June 16th were £1,816, against £2,066 last year. The traffic receipts for the week ending June 30th, 1882, were £1,477, both after deducting "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

West India and Panama Telegraph Company, Limited. The estimated receipts of this company for the half-month ended the 30th June are [illegible] as compared with £2,282 in the corresponding period of 1881.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 243.

THE POSTMASTER-GENERAL AND THE TELEPHONE.

ON Monday evening in the House of Commons Mr. Fawcett, the Postmaster-General, was asked by Mr. Cross whether he had arrived at a decision as to the applications made by various companies for licences to establish and work telephonic exchanges? Mr. Fawcett's reply will be welcomed by all concerned in the future development of this partially stagnant enterprise, for he has decided to favourably entertain proposals that may be made to him by responsible persons to grant new telephone licences under certain conditions, which may be regarded as giving adequate protection to the public and the postal department. We have on many occasions felt compelled to differ from the Post-office authorities in regard to the future efficiency of the public telephonic service, notably in No. 218 of the ELECTRICAL REVIEW. It was scarcely to be expected that the Postmaster-General could long hold out against public opinion even had he been so inclined, so his conclusion that a telephonic monopoly would not be in the interests of the public is what we have all been expecting and patiently waiting for. Competition is as desirable in the case of the telephone as it is with the electric light, and as the former is doubtless destined to be of much greater service to mankind, the extraordinary activity recently shown in pushing forward our new illuminant will probably be surpassed by the interests of telephony.

The recent law-suits in Edinburgh and London have certainly done much to throw the telephonic industry open to all comers, for had it not been for the evidence there brought forth, and the unusual public interest awakened in the matter, the monopolising company might probably have held its sway for some time yet. As it is, Mr. Fawcett's decision will effect such results as he himself will eventually be gratified at seeing. The position of the telephone at present is rather peculiar, for there are doubtless many new inventions which have only been kept back by the action of the Postmaster-General, ready to compete, the moment they are set at liberty, with the only one at present in operation.

It will be remembered that in our issue of the 8th inst. we stated that we had received from reliable authority the statement that the Postmaster-General contemplated giving up the erection of private telephone wires, and that as far as telephone exchanges were concerned the Post-office authorities would not interfere as long as their own interests were not invaded. Our readers will therefore see that at least as far as half our information was involved the result has proved the correctness of our statements. The truth of the remaining part of our note is only probably a question of time. Referring to the erection of lines, Mr. Fawcett said in the House of Commons, "In case it may be supposed that inconvenience may arise from the multiplication of wires, I may remark that the licence of the Postmaster-General to establish a telephone exchange confers no special power whatever to erect poles and wires on, or to place wires under any highway or private property. The persons to whom a licence may be given will have to make their own arrangements with the local authorities and with any persons whose property may be affected. It may be well to add that the licence of the Postmaster-General confers no authority to carry on telephone business with any instrument the use of which would be an infringement of any patent." We should not imagine that telephone companies will find any insurmountable difficulties in regard to the erection of their lines on private property. Private telegraph lines have been put up in very many instances, and we do not anticipate much opposition in this respect to the introduction of the telephone. When the Telegraph Act was brought in and the Government took over the telegraphs, it was never intended that the Post-office authorities should erect private lines, and if they have done so it has been ostensibly for the convenience of their customers and not for the sake of any revenue derived from such a proceeding. It would, therefore, be advisable that the Postmaster-General should not take any further action in putting up private wires, but allow this to be performed by private companies exclusively. It is certainly unfair on the part of the postal authorities to compete in any way with private concerns, as the latter are placed at such an enormous disadvantage owing to the former having the power to put up poles and wires without obtaining the permission of those on whose property they are erected. The matter of patent rights will of course necessarily have to be settled by the competing companies, but what may be used, and what not, is now pretty generally known since Mr. Justice Fry's decision in the trial of the United Telephone Company *v.* Harrison, Cox-Walker & Co.

We said in our article bearing upon this subject, and published in the ELECTRICAL REVIEW of January 28th, that from the standpoint of efficiency to the public service we thought that competition should be allowed, an equal royalty in all cases being required. We also added that if the existing services were good, and if the desirability of intercommunication between one member of a community and any other member of that same body be so apparent, why then competition might fairly be allowed, for it could do but little harm. But if, on the other hand, the service was indifferent, wanting in energy, or the charges immoderate, then competition was the very thing to effect a cure, and therefore whichever way the question was regarded, the then action of the Postmaster-General was as unjust as it was unnecessary. The present action of Mr. Fawcett has, however, now improved the aspect of the whole matter, and the telephonic inventions which might then have been consigned to oblivion, will now have an opportunity of competing with those which have hitherto held the monopoly. When the British and Irish Telephone Company was in correspondence with the secretary of the General Post-office, one of the arguments advanced was that "this company only seeks the privilege of affording the public a far cheaper, and they hope, a better telephonic service by means of exchanges than the associated companies give, in addition to selling the best telephones for private use, which the other companies have agreed not to do."

The result of Mr. Fawcett's deliberations will be that the public will have the advantage of not merely one better system than that at present in use, but of selecting from numerous competing systems that which is best adapted from all points for the various purposes required. The United Telephone Company has never been able to instil much energy into its own movements, and the Post-office, which for awhile seemed to threaten opposition to it, fared, telephonically, still worse. It is therefore a wise proceeding on the part of Mr. Fawcett to allow new blood to come upon the scene and to carry out operations which the above named company and the Department have signally failed to achieve.

The "scientific toy" has now taken a firm stand in the necessities of our every-day life, and bids fair to be the most useful assistant we can ever expect, wherewith to carry on the commonest, or the most momentous business transactions of our daily life.

WILLOUGHBY SMITH ON INDUCTION.

IN a small pamphlet recently printed Mr. Willoughby Smith has given the results of some interesting experiments which he has recently made on "Induction." The most important of these relate to the measurement of the "specific inductive resistance" of various materials. The meaning of the term specific inductive resistance, in contradistinction to specific inductive capacity, is made clear by the following experiments of the author :—

Two equal lengths of copper wire insulated with gutta-percha were wound side by side upon a wooden reel and immersed in water. The specific inductive capacity of each length was ·084 of a microfarad. Now, to measure the "specific inductive resistance" of the dielectric, the two ends of one of the coils were connected to a galvanometer, and the other coil was then charged to the same potential as when measuring its specific inductive capacity. The deflection on the galvanometer caused by induction from the charge in the other coil was, say = 1. Two precisely similar lengths, and of the same dimensions, but insulated by a dielectric of known high specific inductive capacity, were then tested in the same way, and the following results obtained :—

Specific inductive capacity = ·288 microfarads.
Deflection on galvanometer = ·94 ,,

showing, the galvanometer deflection being less, that there was less inductive effect through the dielectric of high specific inductive capacity, or in other words that the specific inductive resistance was greater. It therefore follows (says the author), that for the dielectric of a long line of telegraph, either submarine or subterranean, where one conductor is alone employed the dielectric of the lowest specific inductive capacity is the most suitable; but where it is desirable to lessen as much as possible induction between parallel wires in close proximity, and of comparatively short lengths, then the dielectric of the highest specific inductive capacity would be the more suitable of the two.

In order to determine the specific inductive resistance of various metals, the author had the apparatus shown by the figure constructed. In this apparatus

A and B are two flat spirals fixed a suitable distance apart. In circuit with A was a battery, C, and reverser, D, and in circuit with B a similar reverser, E, and an astatic mirror reflecting galvanometer, F. The reversers were so arranged that E should reverse slightly in advance of D, and by that means a large and steady deflection was obtained, the galvanometer being always affected in the same direction by the induced currents set up in B. A plate of the substance to be tested was then placed midway between the spirals, as shown at G, and in proportion to the interception of the lines of force so were the deflections on the galvanometer; and thus, by this arrangement, very accurate and sensitive measurements could be made. By this method the following results were obtained, showing the percentage of inductive radiant energy intercepted by plates of metal sixteen inches square and half an inch thick.

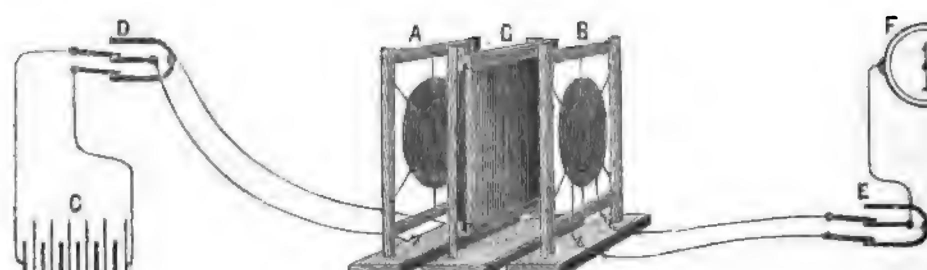


TABLE 1.

	Interception per cent.
Copper	44·1
Tin	3·5
Lead	·4
Zinc	11·9
Steel	55·3
Iron	57·0
Compressed Iron Filings	10·0

It was observed that time was an important element to be taken into account whilst testing the above metals, that is to say, the lines of force took an appreciable time to polarise the particles of the metal placed in their path, after having accomplished which they passed more freely through the same. That being so, the thought naturally occurred, *Would the results be effected by varying the speed of the reversers, so as to increase the number of the lines of force striking the plate under test in a given time?* The results given in the following table clearly show that this surmise was correct; and the knowledge gained opens out another large field for earnest thought and further investigation.

TABLE 2.

Metal under Test.	Per cent. of Inductive Energy intercepted at various speeds. Number of Reversals per Minute.							Conductivity of the Metal pure Copper = 100.
	384.	432.	504.	560.	624.	720.	Mean.	
Copper	44·1	49·6	55·2	59·4	62·1	67·5	56·3	73·0
Brass	9·3	11·3	14·7	19·9	23·9	26·5	17·6	20·4
Tin	3·5	7·4	7·4	9·7	11·3	13·1	8·7	17·4
Lead	·4	4·0	3·0	2·8	5·0	5·2	3·4	6·4
Zinc	11·9	16·1	20·2	23·6	26·0	30·9	21·4	33·3
Steel	55·3	56·8	57·6	58·0	59·0	59·8	57·7	11·7
Iron	57·0	58·1	57·8	58·4	59·8	60·0	58·5	13·8
Iron Filings	10·0	—	—	—	—	18·5	14·2	—

It will be noticed by reference to the foregoing table that the percentage of inductive energy intercepted does not increase for different speeds of the reversers, in the same ratio with different metals, the increase with iron being very slight, whilst with tin it is comparatively enormous. The following table gives the percentage of increase for each metal experimented with :—

TABLE 3.

Metal under Test.	Per cent. of Increase.
Copper	53
Brass	185
Tin	274
Lead	—
Zinc	160
Steel	8·1
Iron	5·3
Iron Filings	42·

Sheets of metal similar to those in the tables, but only 1-8th of an inch thick, in no way intercepted the lines of force.

If for each metal the mean of the results obtained with various speeds (*see* Table 2) be compared with the specific conductivity of the same, it will be seen that in each case the specific inductive resistance is in the same direction as that of their specific conductivity, with the exception of the magnetic metals iron and steel; that is to say, the higher the inductive resistance the higher the conductivity.

When two metals are combined to form an alloy, the resistance of the alloy is in most cases greater than that calculated from the resistance of the component metals and their proportions. The specific inductive resistance of alloys appears to follow in the opposite direction. For example, the percentage of inductive radiant energy intercepted by copper is 56·3, and that of zinc 21·4,

but an alloy composed of sixty parts copper and forty parts zinc only intercepted 17·6. The following will further illustrate the subject:—

Composition of Alloy.	Interception per cent.	Calculated.
67 parts Copper, 33 ,, Zinc	14·6	45·6
62 ,, Copper, 37 ,, Zinc, 1 ,, Tin	14·7	43·6

It will also be observed that the increase in the proportions of the metal copper of the highest specific inductive resistance decreases the inductive resistance of the alloy.

Dielectrics, such as gutta-percha, glass, sulphur, and shellac, as well as fluids and gases, have little or no effect in intercepting the lines of force.

The author found that when an intermittent current was sent through a spiral similar to that shown in the figure, then this intermittence was distinctly heard in an ordinary telephone held at some distance from the spiral, that is, so long as the telephone does not lie exactly in the plane of the spiral. It was found that the sounds were even heard when a copper diaphragm was used. If the coil on the magnet were short-circuited the sounds disappeared.

Referring to Table 1, the inefficiency of lead in interrupting the induction is very remarkable, and points to the inutility of employing lead-covered wires in telephone circuits for warding off inductive action between wire and wire. It is also obvious that iron forms the best protector. It would have been interesting if Mr. W. Smith had continued his experiments by making use of an earth, so as to more nearly represent the actual state of affairs in the case of telephone wires.

REVIEW.

Practical Information for Telephonists. By T. D. LOCKWOOD, Electrician, American Bell Telephone Company. New York: W. J. Johnston, 9, Murray Street.

THE position which Mr. Lockwood holds as electrician to the American Bell Telephone Company naturally gives authority to his work, and any information which it contains we may be sure will be of a thoroughly practical and useful nature. Works which pretend to be merely handbooks of the subject with which they deal are not usually considered to be of more than an instructive nature; but in the book before us Mr. Lockwood has interwoven in a most natural manner a vein of that humour which is seldom met with except in an American, and the result is that the production is both amusing and instructive, and interests while it teaches. Many of Mr. Lockwood's humorous observations are very much to the point, and contain truths which are often unheeded. We have more than once insisted upon the necessity of the apparatus used for testing purposes being not only suited for the object for which it is employed, but also upon such apparatus being handled in a manner consistent with its nature; with reference to this, we find at the conclusion of a chapter on the "Blake transmitter" the following paragraph: "Finally, my brethren, as in all electrical apparatus, when a transmitter is working well leave it alone, and never forget that when repairs or new adjustment is requisite, the instrument is not a four hundred horse-power Corliss steam engine, but a telephone transmitter."

The first chapter of Mr. Lockwood's book gives a short and well-arranged historical sketch of electricity from the earliest down to the present date. We next have "Facts and Figures about the Speaking Telephone," in which it is stated that the first record of a sound transmiting instrument in connection with which the word "Telephone" occurs, is believed to be the English patent of Sir Charles Wheatstone, No. 2462, October 10th, 1860, in which are described "Telephones in which musical pipes or free tongues are acted upon by wind." We fancy the use of the word telephone as a sound transmitter dates considerably further back than 1860. Indeed, some of our readers may remember the well-known "telephonic" concerts of Sir Charles (then Professor) Wheatstone, given at the now defunct Polytechnic Institution very many years back, in which musical sounds were transmitted a considerable distance through wooden rods. Speaking of Reiss's apparatus, Mr. Lockwood says, "that with this instrument even articulate sounds and words were transmitted, received, and understood by *those who knew beforehand what the words were going to be.* This remark seems to us a very forcible one, and considerably changes the aspect of the statement of which so much has been made, viz., that Reiss's telephone anticipated Bell's, inasmuch as it actually transmitted articulate speech. Mr. Lockwood very truly and humorously states that, "between this telephone and the speaking telephone there was a great gulf as wide as the gulf which, in the parable, separated Dives and Lazarus."

The first telephone line, it appears, was constructed early in 1877, and in May of the same year the first practical telephone exchange was operated.

The construction of telegraph or telephone lines, though dealt with in a few pages, is still dealt with in such a manner as to give a very great amount of useful practical information, small but necessary details (which are so often neglected) being given. Mr. Lockwood in giving information, goes straight to the point at once without introducing his remarks with a quantity of useless matter. All the important elements in connection with telephonic communication are dealt with in separate chapters, and while it is done in an entertaining manner, it is done thoroughly practically, thus any one reading the book carefully, ought to have no difficulty in tracing out and removing such faults as usually occur in the apparatus. The sketch of the telephone inspector as he ought to be as contrasted with what he often is, might be read with profit by many and the model copied with great advantage.

To point out the very many excellent points in Mr. Lockwood's little work (for it is but a small one), would occupy too much space, but we can heartily recommend it to all classes of readers. The only fault we can find with the book is, that it is too short and requires illustrations. We are sure that if Mr. Lockwood enlarges and illustrates his present work, he will earn the thanks of many, especially as one can see that he is a man who knows what he is writing about.

THE BAUDOT TELEGRAPH.

(*Seventh Article.*)

Relay.—It has been explained in describing the combiner that the line current does not act directly on the pointing electro-magnets. These are set in motion by a local current dependent on a relay. The relay employed by M. Baudot is shown in figs. 11 and 12; the armature is placed between two copper notches, fixed on the pole of a horse-shoe magnet. It is maintained in this position by its own weight and by the attraction of the magnet, which imparts to it its magnetism by induction. This armature moves between two coils of an ordinary electro-magnet. The magnet is placed in a wooden case, which supports two copper riders, into each of which is screwed the core of the relay coil. The play of the armature is limited by two contact studs. The relays are regulated in such a manner that when the armature is displaced under the influence of a current of a certain direction, it remains in that position until a current of the opposite direction returns it to its original position. Generally the positive current moves the armature to the *marking* contact, and the negative current moves it to the *spacing* contact. The negative current necessary to do this is supplied by a local battery, one pole of which is connected with that of the brushes of the distributor, which traverses the ring of receiving blocks. We have seen that this brush is about two contacts in advance of the brush connected to line which traverses the same crown, the blocks of which are connected to one end of the coils of the relays. Thus, at each turn of the arm of the distributor a negative current is sent into the coils of all the relays, and restores the armatures displaced at the preceding turn before the line current comes again to set them in action, according to the combination to be formed. Fig. 11 shows the perspective view of five relays;

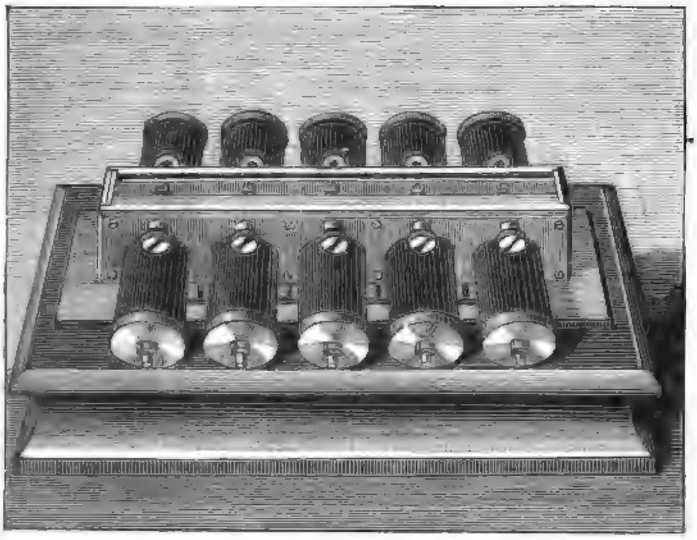


FIG. 11.—QUINTUPLE RELAY.

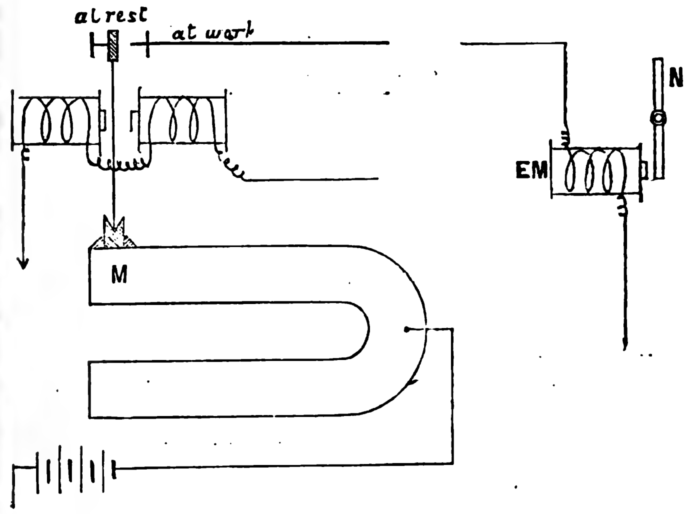


FIG. 12.—DETAIL OF SIMPLE RELAY.

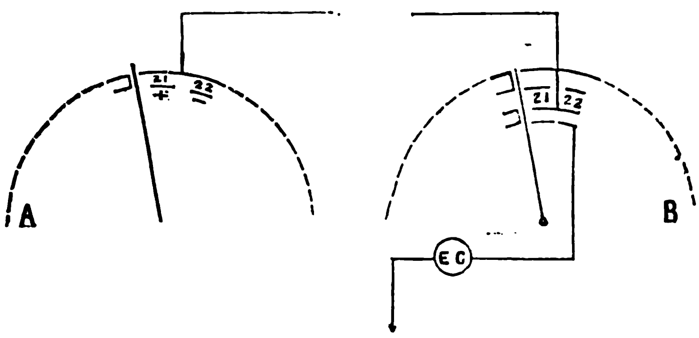


FIG. 13.—CORRECTING SECTOR OF DISTRIBUTOR.

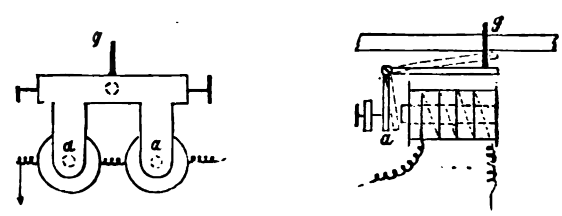


FIG. 14.—CORRECTING ELECTRO-MAGNET.

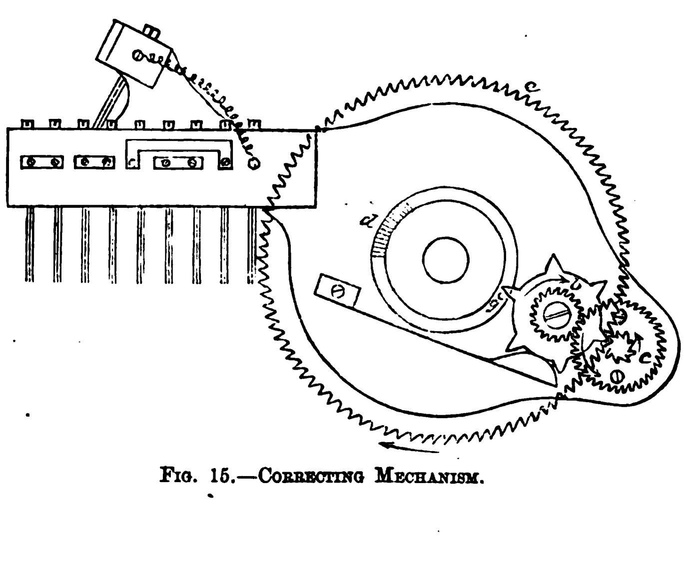


FIG. 15.—CORRECTING MECHANISM.

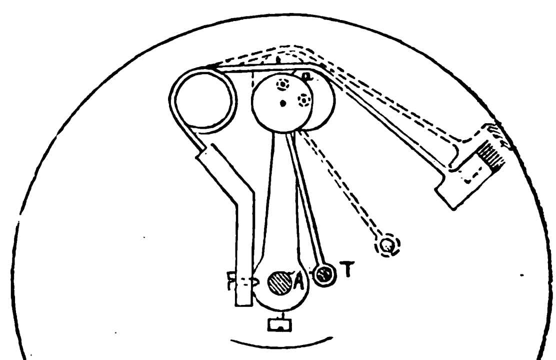


FIG. 17.—REGULATOR BRAKE.

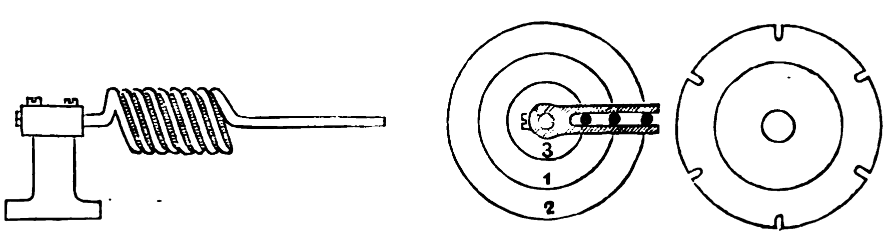


FIG. 16.—VIBRATING ROD OF REGULATOR.

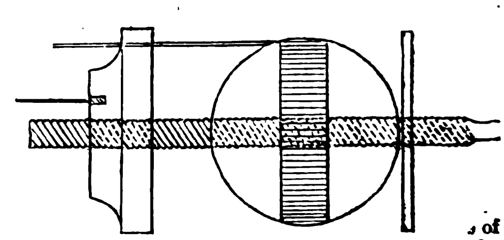


FIG. 18.—ROD OF REGULATOR.

of
the
The
in the
inductive
zinc 21·4

fig. 12 gives details of the relay; the connections indicated on the diagram show how the armature of the pointing electro-magnet follows the movement of the armature of the relay. The pointing electro-magnet is an ordinary one.

Correcting Apparatus.—We are going to complete what we have merely alluded to in the description of the distributor relative to the function of the correcting sector by means of which we arrive at the synchronism of the two distributors at the home and distant stations. Let us imagine a distributor of a quadruple apparatus divided into twenty-two equal contacts; twenty will belong to the four transmitting sectors, and two will serve for correction. We will establish the connections in the manner indicated in fig. 13.

At the station, A (to the left of the diagram), the contact 21, of the second division of the sector of correction, will be connected to the positive pole of a line battery, and the contact 22, of the same division, to the negative pole of a similar battery. These same contacts on the first division being connected to the line, the positive and negative currents will be sent every time the brushes of the distributor establish communication between the two divisions. At the station, B (on the right), the contact 21, of the fourth division, will be put to earth, and the contact 22, of the same division, connected to a relay which will actuate the correcting electro-magnet (fig. 14), and displace the armature, *a*.

The displacement of the armature will raise a pin, *g*, by the movement of the arm of a lever. This pin, dropping into a hole in the distributor, will come in contact with a star-wheel, *b* (fig. 15). This wheel, *b*, has on its circumference six teeth, the intervals between which represent 1-18th of the circumference described by the arm. It is maintained in its position by a cam at the extremity of a flat spring, the other end of which is attached to the frame of the arm. By a pinion, the star-wheel gears into a second-toothed wheel, *c*, also furnished with a pinion which is in connection with the lower wheel of the vertical axle of the arm.

This wheel is put in motion by a bevel wheel fixed to one extremity of the axle of the fly-wheel, it pulls the arm which will turn regularly with it when the correcting apparatus is out of action. But at the moment when the pin, *g*, is raised, the star-wheel stopped by this obstacle will turn on itself in a direction contrary to the general movement, pulling the arm with it. The spring, drawn away during the interval between two teeth, will return of itself in the following interval; there will, therefore, be a delay in the movement of the arm determined by accessory wheels, the number of teeth in which are calculated to correspond to the value of 1-6th of the contact during 1-18th of a revolution. The return of the correcting pin is effected mechanically by means of an eccentric connected to the arm.

Regulator.—In order to correct the effect of sudden variations in the speed of the apparatus a fly-wheel is employed. This is worked by the motor by means of a crown; it constitutes, as we know, a sort of reserve force, which lessens the variations in the speed, but it does not regulate, as it does not insure isochronism.

The regulator, figs. 16, 17, and 18, is similar to that in the Hughes apparatus; it consists of a vibrating rod of steel (fig. 16), slightly tapering in form, and two metres in length. The thicker extremity, coiled into nine spirals, is firmly fixed on a support placed in the prolongation of the axle of the fly-wheel; when the rod is thus brought into an invariable position, its free end rests laterally against the back of the axle of the fly-wheel. It is connected with the movement of this axle by means of a handle consisting of several parts, the whole of which constitutes what we call the brake.

A copper arm is fixed on the back of the axle of the fly-wheel, which it accompanies in its revolutions. The free extremity of this arm is clamped to a cylindrical collet, into which is introduced, with little friction, a small pivot parallel to the axle of the fly-wheel and terminated on the side of the vibrating rod by another arm, bent at its free extremity into the form of a ring.

Into this ring is introduced the free extremity of the vibrating rod. The pivot above mentioned bears on the side of the fly-wheel an excentric cam of ivory, independent of the movement of the rod; on the point, *a*, above this cam, rests a bent spring, as is shown in fig. 17.

On the straight part of the vibrating rod is introduced a solid sphere of copper, which can be moved along the rod to bring it near to, or draw it away from, the extreme end, and thus regulate the speed.—*L'Electricien (M. Ch. Bontemps).*

M. DE MERITENS' NEW MACHINES.

[The following description of these dynamo-electric machines was written for *La Lumière Electrique* by M. Aug. Guerout.]

DURING the ten years that the ring machines have been in practical use they have been subjected to one improvement after another, and the degree of perfection to which they have now attained justifies us in asserting that the problem of transforming mechanical work into electricity is in a great measure solved.

This first and very important condition being arrived at, dynamo-electric machines still present one considerable difficulty: their price is somewhat too high for industrial applications.

This is partly due to the fact that in purchasing machines the consumer often pays for the patent rights, and partly also to a want of attention to the question of economy in the construction at first. The price being once settled and the catalogues published, scarcely any further consideration was given to the subject. But now when the patents of the principal ring machines are on the point of becoming public property, and when also a careful examination of the Pacinotti machine has proved the worthlessness of some of them, the object of constructors should be to offer their machines at the lowest possible rate, so as to bring them into general use.

Several inventors have already turned their attention to this subject; amongst others we shall speak more particularly at present of M. de Méritens, who with this object has directed all his efforts to the Pacinotti machine.

Since that time, he endeavoured firstly to render the employment of his first machine, designated by the letter C, available for public lectures.

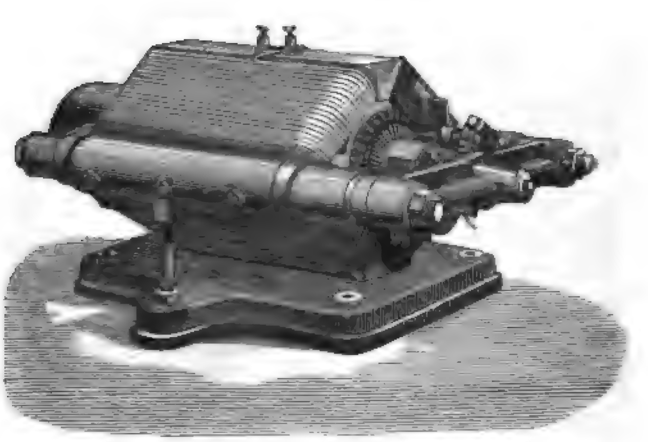


FIG. 1.

In order to do this he added to his model a system of gearing by means of which it could be worked by hand. A large toothed wheel with two handles enables four men to put the machine in motion at the speed required. If, under normal conditions, the work which one man can produce is only six kilogrammes per second, he can after an effort of a few moments arrive at a much higher result. This is why the four men working at the two handles can during a few minutes produce sufficient work to maintain by the machine an electric regulator of 100 Carcel burners. As we see, the light can only be maintained for a very short time, but this period is quite sufficient for purposes of illustration. The professors for whose benefit the apparatus was designed will certainly appreciate a model which enables them to demonstrate practically to their pupils the working of the principal

electric lamps, without resorting to motive force or using fifty battery elements. Without making any alteration in the construction of the first machine, M. de Méritens then designed a second type, designated by the letter I. It only differs from the original apparatus in that it is longer and of larger dimensions. This type has a normal speed of 2,800 revolutions, and can at high tension maintain two lights of sixty Carcel burners. (*See* fig. 2.)

turns like type I, at 2,800 revolutions, and absorbs 2½ horse-power.

The second machine, or type H, can feed a light of 650 Carcel burners with an expenditure of 4 horse-power, turning at a normal speed of 1,600 revolutions per minute. A similar machine can be used for working powerful lights, such as those used in lighthouses.

The same machine can be used to feed 25 incandescent

FIG. 2.

The cylindrical form given to the inducing electro-magnets somewhat complicated the construction of the machine. M. de Méritens thought this construction could be simplified by using flat inductors so as to give the machine the form of a straight prism with a rhombic base. The polar radiations lodging naturally in two angles of the space in which the coil is placed, there is thus no appreciable displacement. This idea suggested two types of machines, shown in figs. 1 and 3.

The first of these machines is designated by the letter J. It is of comparatively small dimensions, and constructed to maintain a light of 180 Carcel burners. It

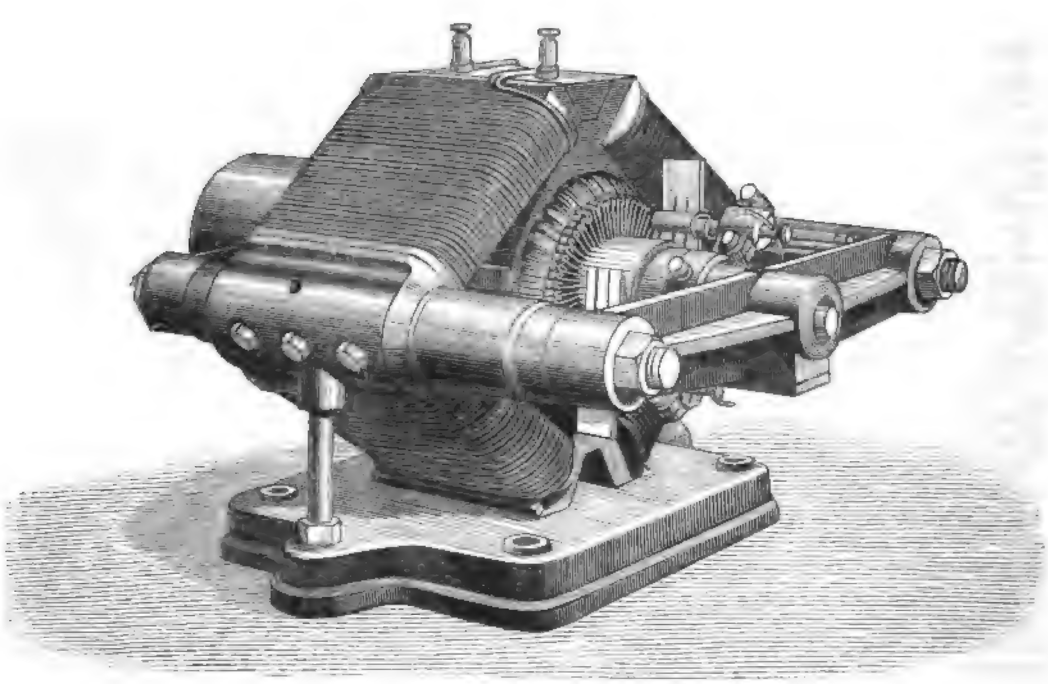


FIG. 3.

Swan lamps of two ampères each; its electromotive force is 80 volts.

The weight of these machines is reduced as far as possible. The first, type C, has been somewhat lightened, and with its present construction weighs only 30 kilogrammes. The type H, which is the most powerful, has a weight of 224 kilogrammes, and the model I weighs only 47 kilogrammes. These weights are, as we see, very moderate in proportion to the power of the machines.

Following the method indicated by M. Marcel Deprez, M. de Méritens studied these different machines, making the external resistances vary progressively.

The accompanying table gives the results obtained with the type C, the inductor and induced coil of which have each a resistance of 1·33 ohm.

Intensity in Ampères.	Electro-motive force in volts.	Resistance in ohms.	Intensity in Ampères.	Electro-motive force in volts.	Resistance in ohms.
10·69	55·05	3·49	4·50	53·95	9·33
9·66	65·11	4·08	4·14	52·04	9·91
8·97	65·66	4·66	3·96	52·07	10·49
8·28	65·41	5·24	3·70	50·08	11·08
7·59	64·44	5·83	3·45	48·40	11·66
6·90	62·58	6·41	3·17	47·26	12·25
6·55	63·21	6·99	3·11	48·17	12·83
5·86	60·0	7·58	3·10	49·82	13·41
5·35	57·88	8·16	2·80	46·62	13·99
5·0	57·0	8·74			

It must be observed that the resistances given in this table are external resistances, and that in order to obtain the total resistance, the resistance of the machine, amounting to 2·66 ohms, must be added to them.

Intensity in Ampères.	Electro-motive force in volts.	Resistance in ohms.	Intensity in Ampères.	Electro-motive force in volts.	Resistance in ohms.
1·0	15·93	15·16	15·72	57·85	2·91
1·20	17·72	14·0	20·29	62·90	2·33
1·41	19·18	12·83	22·50	63·23	2·04
1·73	21·50	11·66	26·38	66·48	1·75
2·12	23·87	10·49	27·69	65·35	1·59
3·0	30·30	9·33	29·23	64·89	1·45
4·0	35·72	8·16	31·80	65·83	1·30
5·66	43·98	7·0	35·10	67·74	1·16
7·35	48·51	5·83	37·51	67·14	1·02
9·54	51·80	4·66	51·45	69·46	0·58
13·19	56·19	3·49			

The second table gives the results of similar experiments made with the machine H, the resistance of which is 0·76. Summing up the characteristics of these machines with the help of the figures contained in the tables, we arrive at results indicating good conditions of construction. We may add that, in the types I and H the prismatic form offers great facilities of construction. The whole body of the machine may in fact be cast in two parts; the coiling of the wire is easily effected on each part, and it is then only necessary to bring them together in order to constitute the framework of the apparatus, in which we have only to adjust the induced ring.

Before concluding this article, we will indicate one more improvement effected by M. de Méritens, not in dynamo-electric machines, but in carbons for lighting. For powerful lights, such as the lamps for lighthouses, especially in the large lighthouses of England, carbons of very large diameter are used. Now it is very difficult to get these large carbons of the same composition throughout, and besides, the greater part of the time their rate of consumption is not equal. The external parts are naturally more dried up and consume quicker than the central parts. These two circumstances prevent the regular consumption of the carbons and thus affect the steadiness of the light. In order to overcome this difficulty, M. de Méritens conceived the idea of substituting for the large carbons a number of small rods of the same material, each having a diameter of three to four millimetres. These rods are connected together by fastenings of copper wire, and their number is proportionate to the thickness of the cluster employed. Each rod is covered with copper, and so is the whole cluster. In this manner the rods are well held together, and form a whole which may be considered very homogeneous on account of the very slight thickness of the layers of copper deposited by the battery.

These compound carbons give a very steady light, and we notice even that besides the regularity the light obtained is more intense than with rods in one single piece.

We can easily understand that this should be so, since every part of the cluster being consumed equally, disturbing influences are no longer produced in the central parts.

Clusters of this kind, 4 centimetres in diameter, have been tried in the large models of the English Lighthouse Administration, and have produced results in every respect satisfactory, so that the clusters will henceforward replace the old carbons

THE ELECTRIC LIGHTING BILL.

A SPECIAL sitting of the House of Commons was held on Saturday to further consider this Bill.

On the motion to go into committee upon the Bill,

Colonel Makins said that instead of waiting until the third reading before bringing on the motion standing to his name, he had decided, after consulting with the President of the Board of Trade, to mention the matter to-day; but as the forms of the House precluded him from making the motion now, he would content himself with drawing attention to the question. But although he was connected to a great extent with gas companies, he did not on this occasion represent their views. He believed gas companies generally were content with the details of this measure, and looked upon it as a strong and successful attempt to grapple with a difficult question, but they were opposed to it on two points of principle. No legislation on this matter would control or affect the competition between the various systems of electric lighting now in existence, such competition would eventually be decided by efficiency and economy alone. Gas companies were not alarmed by the progress which had been made in electric lighting in the last few years, for not only had gas the advantage of forty years' start and enormous capital, but the progress made in electric lighting was as yet more of a scientific than of a practical nature. As much, or nearly as much, capital had been subscribed towards fifty-five electric lighting companies in the last few weeks as had been expended on gas in the last forty years, namely, £13,000,000 or £14,000,000. But he was afraid that the greater portion of that sum would find its way into the pockets of experimentalists and patentees. The two points he wished the House to consider were, first, the powers taken by the Board of Trade to grant licences to companies and persons to supply electric light, and, secondly, the powers which the Bill proposed to confer on corporations to make experiments without consulting the ratepayers whose money might thus be squandered lavishly. Hitherto the power to grant licences had rested with Parliament, and it was quite a new departure for one department of the State to usurp this power. Then, under section 2 the words "public purposes" had acquired a new meaning, and would include not only streets but churches, vestry-halls, and theatres. He maintained that a theatre could not be called a public place. This power would also enable the local authorities to use the money raised by rates for supplying electric light to private consumers, and he did not think corporations had ever before possessed such a power as that without first having obtained the sources of supply. He also considered it most improper to permit local authorities to have the power of using the money of the ratepayers for what might be termed speculative purposes, more especially as there was nothing in the Bill providing for ratepayers having any control over their representatives. He would, therefore, move, "That it is undesirable to retain in the Bill the novel powers proposed to be given to the Board of Trade to grant licences to local authorities or persons enabling them to exercise powers hitherto only granted by Act of Parliament, or provisional order confirmed by Act of Parliament, and the power given to local authorities under clauses 5 and 6 and other parts of the Bill to raise money on credit of local rates without the consent of the ratepayers, for the purpose of competing with private capital, are contrary to every principle hitherto recognised by the Legislature, and that no Bill containing such powers will be acceptable to this House."

Mr. Carbutt agreed with the hon. member in condemning this new departure in legislation, which might hereafter be applied to railways and entail great loss on shareholders. It was opposed to every principle of political economy, and violated the principle of fair dealing. The public wanted electric lighting, but wished private enterprise to develop it, and then they would come in and buy up the successful undertaking the moment it paid at the price of old material. He protested against such a proposition.

Mr. Slagg argued that the value of undertakings could not be arrived at now, and wished to know why private outside companies were to be encouraged to make enormous profits out of the public without local authorities being possessed of such a power as that proposed by the Bill.

Mr. W. Fowler thought electric lighting companies ought to have at least as long a term as tramway companies, who had twenty-one years. People had gone wild about electric lighting at present, no doubt, but they subscribed their money for speculative purposes thinking they would be able to sell their shares at great profit. The Government was going too far in discouraging private enterprise.

Mr. Chamberlain said the questions raised by the hon. member for South Essex were important. The other questions could be considered in Committee. This Bill had already been exhaustively considered by the Select Committee presided over by the hon. member for Mid-Lincolnshire (Mr. Stanhope). He admitted that the power to grant licences was a new one, but it was founded on the recommendation of the Committee which sat in 1879. The object of the Government was to facilitate experiments in electric lighting, and this method was thought to be more economical than the old method of provisional order. The Board of Trade would hear evidence on both sides before granting a licence to a local authority, and then the licence would be restricted to five years. The question as to the definition of "public purposes" was of little importance. As to the question whether it was justifiable to place public money in competition with private capital without the consent of ratepayers, there were precedents for that; and he considered that corporations were degraded by so much supervision by ratepayers as that conferred by the Borough Funds Act, an Act which he hoped to see amended or repealed altogether.

Mr. Warton protested against this assumption by the Board of Trade of duties which properly belonged to other departments of the Government. It was not in any sense a scientific body, and the president merely desired to magnify his office; and that department

ought not to be allowed to trammel the progress of inventors and experimentors, who ought to be allowed to make their own way in the world as others had done before them.

Mr. MacIver said all that was wanted was that electric lighting companies should have fair play, as other companies had. He agreed with the hon. member for Bridport in protesting against the Board of Trade taking upon itself duties which ought to be left to more suitable departments.

Colonel Makins said, after the discussion which had taken place, he would withdraw his amendment.

The amendment having been accordingly withdrawn,

The House went into committee on this Bill.

Clause 1 was agreed to.

On Clause 2 being proposed,

Mr. Warton moved that music-halls should come under the definition of public places.

Mr. Chamberlain said it was immaterial whether music-halls were lighted by public or private licence.

Mr. Warton said it might become important hereafter in regard to enforcing regulations for public safety; but he would withdraw the amendment.

Mr. Carbutt moved that licences should be granted for seven years instead of five.

Mr. Chamberlain said licences were renewable with the consent of local authorities.

Sir John Lubbock asked what would be done if an agreement was made for ten years.

Mr. Chamberlain replied that a licence could only be granted for five years, but an agreement might be made with the local authority to assent to a renewal.

Mr. Serjeant Simon observed that a corporation was a perpetual body, and unless it possessed powers as strong as those to be used under the Bill, no one would enter into agreements with it.

Mr. Shaw hoped the opinion of the local public would be ascertained, as corporations did not always reflect that opinion. If the five years' limit were retained, unless the companies cared to apply for so short a licence, the Bill would probably become a dead letter.

Mr. Chamberlain explained that the Board provided for local inquiries to be held whenever they were desired. With regard to the five years' licence, it was possible to proceed by Provisional Order as well, and if the period of the licence were extended the House would lose the authority it possessed by means of provisional orders.

After some further discussion the amendment was withdrawn.

In reply to Colonel Makins the Attorney-General said there was no limit to the renewals of licences.

Colonel Makins entered a protest against the system of licences, believing they would work injuriously to public interests.

Clause 2 was agreed to.

Clauses 3 and 4 were also agreed to, but on clause 5

Mr. Pugh moved an amendment preventing local authorities incurring the expense of carrying out a scheme for electric lighting, without first obtaining the consent of the ratepayers.

Colonel Makins supported the amendment, but thought its object might be attained by making a preliminary inquiry compulsory.

Mr. Chamberlain said the best security for the honesty of the local authorities was in making them thoroughly responsible, and not in keeping them in leading strings. A local inquiry must take place before a corporation could borrow money, and the Board of Trade would encourage such inquiries.

The amendment was eventually withdrawn and clause 5 was agreed to.

Clauses 6 to 13 having been agreed to,

On clause 14, provision for the protection of the Postmaster-General, and for the purchase of undertakings by local authorities,

Mr. W. N. Nicholson moved an amendment extending the time after which a local authority might require persons who supply electric light within its jurisdiction to sell their undertaking from 15 to 21 years.

Mr. Chamberlain said the period of 15 years was a compromise fixed upon by the select committee between the two periods which had been suggested, and they were of opinion that that time would be sufficient for experiments to be made. The committee had two objects in view: first, not to throw obstructions in the way of companies; and, secondly, to protect the interests of the public from suffering from such monopolies as gas and water companies had obtained. He believed all the electric companies, with the exception of the Edison Company, had expressed their satisfaction at the period fixed. He was of opinion that the time given should be long enough to enable the companies to make satisfactory experiments.

Mr. Carbutt supported the proposal.

Mr. Slagg and Mr. J. Jenkins thought fifteen years sufficient.

Mr. Story-Maskelyne said several companies had informed him that they were satisfied with fifteen years, and—

Mr. W. N. Nicholson withdrew the amendment, being satisfied with assurances that the companies generally were satisfied with the time fixed.

Mr. J. K. Cross moved to introduce the following words in the purchase clause: "With such addition for goodwill as may be agreed upon, or, failing agreement, as may be determined by arbitration, but without any addition for compulsory purchase; and, provided always, that the sum paid shall not exceed by more than 25 per cent. the value ascertained as aforesaid. When a part only of the undertaking is purchased, payment shall be made on the same terms, but with such addition as may be requisite to compensate for loss occasioned by severance."

Mr. Rathbone opposed the amendment, believing that it was antagonistic to the public interest.

Sir John Lubbock asked the President of the Board of Trade to explain the clause.

Mr. Chamberlain said this clause had been drawn up with the intention of insuring that the purchasers should pay the same price as if they bought in the open market. If the local authorities were debarred from purchasing the undertaking at the end of a reasonable term at a reasonable price, they would only have the alternative of setting up in business for themselves; therefore he thought the amendment was against the companies.

Mr. Cross withdrew his amendment.

Clauses 14, 15, 16, 17, 18 and 19 were then added to the Bill.

On clause 20,

Mr. J. Hamilton moved that so far as Ireland was concerned the Local Government Board should be substituted for the Board of Trade.

Mr. Chamberlain said he was willing to take the opinion of Irish members on this point, although he thought it would be better that the management should all be in the hands of one body.

Mr. Stanhope advised that the control for England, Scotland and Ireland should be in the same hands.

The amendment was, however, withdrawn and clause 20 agreed to.

Mr. Barran next moved the following new clause:—"No application for a provisional order on the part of any company or person shall be made in respect of all or any part of the district of a municipal, or other local authority, without six months' notice in writing (which shall define the area intended to be comprised therein) to such authority, who shall, within that period, be entitled to make application for a provisional order in respect of all or any (including the area defined in such notice) of such district; and until such application has been disposed of no other application shall be entertained."

The Hon. Member hoped the committee would see how necessary it was that the supply of electric light should be controlled by the local authorities. In the case of the gas supply to Leeds, the difference between the cost of gas when in the hands of private companies and the corporation was remarkably significant. The companies, which were bought up by the corporation for £800,000 or £900,000, charged from 3s. 6d. to 4s. 6d. per 1,000 cubic feet, but the corporation supplied gas to the city and some outlying districts at 1s. 10d. per 1,000 cubic feet.

Mr. Chamberlain agreed with the principle of the proposed clause, but thought it was not necessary as the Bill contained similar provisions. He could not accept the clause.

Mr. Stanhope said the select committe had discussed the question of notice very exhaustively, and had come to the conclusion that three months were quite long enough for a corporation to make up its mind, and therefore he hoped the new clause would not be accepted.

The committee divided, with the following result:—

For the clause	29
Against	88
Majority ...	59

The clause was rejected, and the schedule having been agreed to, the bill was reported.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

FIRE RISKS FROM ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Sparks falling from the carbons of an arc lamp are no doubt a source of danger; and the fire insurance offices, in the exercise of their duty, are quite right to turn their serious attention to the subject. There are other fire risks attending the careless use of the electric light of which cognisance must also be taken; but one fails to see the relevancy of a great deal of the gratuitous advice contained in the somewhat fussy "Rules and regulations for the prevention of fire risks arising from electric lighting," which the Council of the Society of Telegraph Engineers and of Electricians have been pleased to issue.

Their first "rule" for the prevention of fire risks is that "the dynamo machine should be fixed in a dry place;" scarcely, it is to be apprehended, because if fixed in a wet place it would be likely to set the wet on fire. But the Council have no doubt their good reasons for considering that fire risk would be increased by dampness of the machine, although they don't state why.

"It should not be exposed to dust or flyings" (whatever the latter may be), is rule 2; and if the nature of dust and "flyings" is to be explosive or combustible, the Council are right in mentioning them as amongst the fire risks. Much the same may be said of many of the other rules.

In the middle of the rules and regulations the Council

strongly urge—in three separate paragraphs, one beginning with N.B.—"the employment of safety fuses;" but they do not mention the name of the patentee, nor give his address, in case one may have occasion to communicate with him. One concludes, therefore, that he must be the man in the moon, whose name does not appear on the committee, but who has probably mentally influenced these rules, regulations, and N.B.'s. As I understand the description of these fuses, which "are of the very essence of safety" [beware of fraudulent imitations!], they amount to no more than the old French lightning guard of Breguet, in which a fine iron wire was fused when too much (atmospheric) electricity happened to go through it. But the safety fuse, which is "of the very essence of safety," recommended by the Council, is "constructed of easily fusible metal, which would be melted if the current attain any undue magnitude, and would thus cause the circuit to be broken," and, I conclude, put all the lights out. I cannot help thinking that this fuse, which may be "of the very essence of safety," is not of the very essence of originality, and one cannot be sure whether the united genius of the eighteen gentlemen who are responsible for this indirect, and perhaps unconscious, advertisement, might not be able to suggest something much more refined. But the matter is at least relevant to the subject of fire risks, which is more than can honestly be said for a good many of the rules.

A second N.B. (which by the way has no connection whatever with the rule which precedes it), recommends the frequent testing of the wires. We are told: "It is an operation, skill in which is easily acquired and applied,"—particularly when using certain testing apparatus, invented probably, by the man in the moon; but this is not specified.

The Council then proceed to give a rule and regulation that "the escape of electricity cannot be "detected by the sense of smell," after which effort of originality, we are comforted by the assurance that "it can be detected by apparatus far more certain and delicate;" and it might have been added to this—"portable and guaranteed to be of the best workmanship, and the invention of the man in the moon."

The final rules for the prevention of fire risks are to the effect that wires should be arranged so that no one can be exposed to the shocks of alternate currents exceeding 60 volts, but it is not stated whether this is for fear of the individual being set on fire; and that if the difference of potential within any house exceed (the Council say exceeds) 200 volts the *outside* of the house should be provided with a switch, so arranged that the supply of electricity can be at once cut off—probably in the event of a passing policeman seeing any of the inmates in a state of incandescence at the windows.

It is, at first sight, not quite clear where the Council obtained such exact information regarding the danger point—viz., 60 volts—of alternate current circuits (though why 60 volts in particular rather than 50 or 70, most of us are as ignorant as probably the Council themselves), while they do not say anything about the much higher potential differences found in some of the continuous current systems. It would not be an incorrect statement that the majority of instances in which death has resulted from incautiously touching wires, has been in connection with systems employing continuous currents. Surely the man in the moon cannot have invented a continuous current machine!

In all systems, care has to be taken to keep out of danger, and people will learn to avoid new dangers just as they have learnt to avoid old ones, such as keeping gas streaming into a room for an hour or so before lighting it; or to avoid taking hold with the naked hand of the business-end of a red-hot poker.

The intention of these rules is admirable, but it is doubtful whether the rules themselves are quite up to what we would have expected. There is a strong suspicion of oblique puff in some of the paragraphs, and these are served up amongst a good deal of very common knowledge, and a little grand-motherly twaddle, all which could have been done just as well without the imposing array of eighteen scientific gentlemen, one half at least of whom have had no practical experience whatever in connection with the subject upon which they undertook to legislate. Truly in this case, as in that of the lightning-rod committee, the mountain in labour has brought forth a mouse. Seeing that this effort of intellect has been issued gratis, unlike the report of the lightning-rod committee, which cost 5s., it may be thought, perhaps, a little ungracious not to pass it over in silence; but when the council of an important scientific society, with high aims and serious work before them, go out of their way to prove over again the truth of the old saying, that gratuitous advice is worth just what it costs, one cannot help regretting that their efforts were not devoted to a more useful purpose.

Faithfully yours,
C. E.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Will you kindly inform me, through your columns, when the Honorary Council of Advice of the late International Electric Exhibition held at the Crystal Palace are likely to make known the jurors' awards to the exhibitors of the same, as I am informed that the second exhibition of electric appliances will shortly take place, and the forms applying for space should be filled in and returned before August 1st next?

As an exhibitor in the last exhibition I do not feel justified in making application for space until I know the result arrived at by them—whether it be satisfactory to the general body of the exhibitors or not, and in that interest I shall be glad to know the result.

I am, Sirs, yours truly,

July 18th, 1882. DISQUE.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The documents sent you by Mr. Silvanus Thompson, in his letter of the 1st instant, relating to the results obtained by Reiss, are evidently interesting, and I shall endeavour to reproduce them in the next edition of my work on the telephone; but they will scarcely alter my ideas as to the share to be ascribed to Mr. Reiss in the discovery of the *speaking* telephone, for if he did effect the reproduction of speech, he only did so, in my opinion, accidentally, for nowhere does he mention the grand principle of the intervention of undulatory currents, which alone could lead to this remarkable result. For sounds to be reproduced by a receiver consisting of *an iron wire enclosed in a helix and stretched on a sounding case placed on a table* (the only Reiss receiver known), the currents sent by his transmitter must have been *interrupted*, and hence the reproduction of articulate speech *could only have been effected accidentally* when the two contacts were by chance maintained one against the other; and as this contact, when prolonged, would stop the sounds on account of the limited extent of the variations in intensity of the currents with such contacts, only irregular and discontinuous effects could be obtained. If the telephonic receiver had been adapted to be held at the ear speech might have been heard in a more continuous manner; but I have never heard of a Reiss receiver so constructed. However, according to Prof. Dolbear, Reiss had constructed a model with an electro-magnet and an armature. Was it with this receiver that the effects quoted by Mr. Thompson were obtained?

However this may be, it seems probable that if Mr. Reiss had really penetrated the principle of the articulating telephone he would have substituted for the metallic contacts some of moderate conductivity, so as to obtain a greater extent for the variations in intensity of the currents transmitted, and he would, besides, have arranged his telephone to be applied to the ear, if his principal object had not been to reproduce musical sound sufficiently loudly to be heard at a distance, and by several persons at once. The prospectus of which Mr. Thompson speaks proves nothing, for it is very certain that if the problem of *seeing to a distance* is one day solved, it cannot be said that it was effected two years ago, as the American newspapers said that *a means had been discovered of seeing by telegraph*. At this rate it might also be said that Manzetti, of Aosta, also discovered the telephone, for in 1865 a number of journals announced that he had found out a means of transmitting speech.

It is probable that in this matter, as in the greater number of modern inventions, the original inventor obtained only insignificant results, and that it was the man who first succeeded in arranging his apparatus so as to obtain really striking results that received the honour of the discovery, and rendered it popular. Nevertheless, it would not be just not to acknowledge that the Reiss telephone *formed the starting-point of all the others*; and that is what I have said and repeated in all my writings. Mr. Bell himself owned it in his paper, which was read at the Society of Telegraphic Engineers in London. As a last argument I will say that if the transmission of speech had been obtained by Mr. Reiss in 1863, as Mr. Thompson asserts, the discovery would have attracted as much attention at that time as when it was announced to us from America in 1876. I now come to Mr. Henry C. Buck's letter inserted in the ELECTRICAL REVIEW for the 15th inst. It is said there that Professor Dolbear had invented his telephonic system before the date which I have fixed for the researches of M. Herz. If this be so, how is it that the system, the excellent effects obtained from which I observed myself at last year's exhibition, was not made public before the middle of the year 1881? Mr. Buck will admit that a writer can only speak of inventions that have become public, and he will also acknowledge that as regards this question of priority we can only depend on the dates of patents or of publications appearing at certain periods. Now, the American journals, at any rate those we have received in France, did not begin to speak of Professor Dolbear's telephone with condenser until the middle of 1881, and even after having described M. Dunand's system. Mr. Buck, in his letter, does not touch upon the date of Professor Dolbear's first researches. It seems to me, however, that instruments of such importance deserved to occupy the attention of scientific journals as soon as they were constructed. All that I can say is that the patent of Dr. Herz dates from the beginning of June, 1880. I will also say to Mr. Buck, as well as to Mr. S. Thompson, that, being in no way interested in this question of invention, I wish to write in the interests of truth alone, and that when my assertions are *proved* to me to be incorrect I am quite ready to rectify them.

TH. DU MONCEL.

Lebisey, *July 17th*, 1882.

NOTES.

SCIENTIFIC REPORTS ON ELECTRIC LIGHTS.—We extract the following from the advertisements of J. B. Rogers' Electric Light and Power Company. It is from the report of J. E. H. Gordon, Esq., B.A., M.S.T.E. :—

Having been requested by the directors to examine Mr. Rogers' Electric Incandescent Lamps, I visited his show rooms, 47, Holborn Viaduct, on the evening of June 1st, 1882.

As a preliminary step to the determination of the efficiency, I took a lamp at random from the electrolier and had it moved into a dark passage behind the show room, where I determined its candle-power. I found it to be 34 candles.

On June 2nd, 20 lamps, including the one whose candle-power I had taken, were sent to me to experiment on. The result of a number of experiments showed that when worked to 34 candles, the lamps had an efficiency of 242 candles per electric horse-power.

This is an extremely high efficiency, being sensibly equal to that of the Swan lamps, and much superior to that of Edison's.

In order to test the strength and probable durability of the lamps, I worked some of them with powerful currents at temperature and candle-power much above those at which they are intended to be used.

I worked one of the 34-candle lamps to a light of 140 candles, when the efficiency was no less than 536 candles per electric horse-power. The lamp stood this enormous temperature for $5\frac{1}{2}$ minutes before the filament broke. I consider this a very severe test of the strength of the filament, and the result an eminently satisfactory one.

To sum up, I can speak in high terms of the lamps constructed by Mr. Rogers.

We are astonished that men of high scientific standing should allow themselves to pose as authorities on electric lighting without first being sure that their statements are correct.

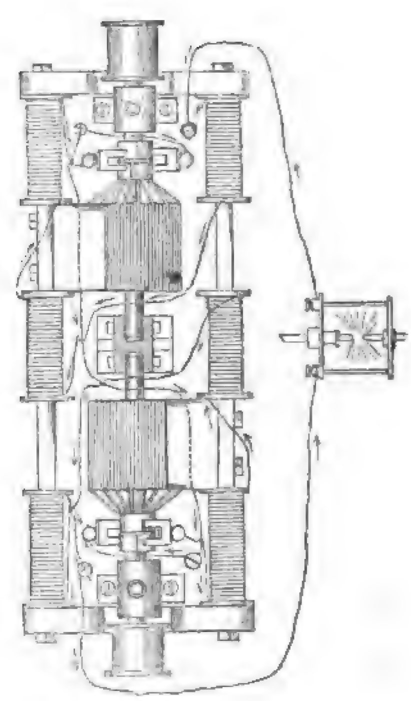
Taking Mr. Gordon's first assertion that the Rogers lamp when worked at 34 candles gives an efficiency of 242 candles per electric horse-power, this result is said to be sensibly equal to Swan's, and much superior to that of Edison's.

We beg to call Mr. Gordon's attention to the paper by W. Crookes, F.R.S., reporting on the incandescent lamps at the late Electrical Exhibition in Paris, and published in full in our issue of June 17th. When the Edison lamps were worked at 32 candle-power (two less than that of Rogers', be it noted), the efficiency per horse-power averaged 300 candles. Therefore even nine months ago the Edison lamps showed a higher value than the present Rogers lamp by nearly 20 per cent. In regard to the second experiment of Mr. Gordon, which is useless and misleading, we need only mention that months ago single Maxim lamps were tested by Professors Ayrton and Perry from their normal candle-power to 1,000 or more, and that the efficiency per electrical horse-power rose to 1,100.

We can only express our regret that Mr. Gordon should lend his name to any company without satisfying himself as to what has been published before concerning the value of the incandescent lamps at present in use. As the public must necessarily depend upon scientific authority for basing their decisions before investing, it would be well if experts dropped the misleading and utterly valueless methods generally adopted in wording their reports.

DYNAMO-ELECTRIC MACHINE.—Patent No. 259,791, filed in the United States of America Patent Office November 21st, 1881, by Charles E. Ball :—

Brief.—The armatures are revolved before one pole only of the field-magnet. Two armatures are mounted on independent shafts and connected in series with each other and the field-magnet coils, each armature rotating before one pole of the field-magnet.



Claim.—1. In a dynamo-electric machine, a single electro-magnet and an armature located and adapted to rotate within the inductive field of only one of the poles of such magnet, substantially as set forth.

2. In a dynamo-electric machine, the combination of two armatures and an electro-magnet or magnets, each of said armatures being arranged and adapted to rotate in the inductive field of only a single pole of such magnet or magnets, substantially as set forth.

3. In a dynamo-electric machine, the combination of two armatures and two poles of an electro-magnet or magnets, each of said armatures rotating in the inductive field of only a single pole, and said armatures and magnet or magnets being in the same circuit, substantially as set forth.

4. In a dynamo-electric machine, the combination of two armatures on independent shafts, whereby they may be rotated in opposite directions, and an electro-magnet or magnets in circuit therewith, each of said armatures being located and adapted to be rotated within the inductive field of only one pole of a magnet, substantially as set forth.

5. In a dynamo-electric machine, the combination of two armatures and an electro-magnet or magnets having pole-pieces on opposite sides of the machines, said armatures and magnet or magnets being relatively arranged substantially as described, whereby each of said armatures is located and adapted to be rotated within the inductive field of only one magnetic pole, substantially as set forth.

6. The combination, in a dynamo-electric machine, of two arma-

tures and an electro-magnet or magnets having pole-pieces on opposite sides, each of said armatures being located and adapted to rotate in the inductive field of only one pole of a magnet, said armatures and electro-magnets being connected substantially as described, whereby the circuit is direct from one armature to the other, and through all the helices of the magnets successively, substantially as shown and described.

7. The combination of two armatures on independent shafts, and an electro-magnet or magnets having pole-pieces on opposite sides of said armatures, the latter being located and adapted to rotate each within the inductive field of only one magnetic pole, said armature and magnet or magnets being in the same circuits, substantially as set forth.

The Maxim-Weston Company's Arc Lamp.—The chairman of the Maxim-Weston Company, in order to show the superiority of the Company's system, gave an extract from a paper by Mr. Sang, read before the Gas Institute in June last. The following comparison of lights was made: Duplex system light, 114 candles; Brush, 557; Maxim-Weston, 1,406. As there is no mention of horse-power used in producing these results they may be put in the category of "Half truths and whole truths." Colonel Gilbey, in the course of his remarks, said he believed that wherever the Company's lights were shown they extinguished everything else. Leaving these egotistical remarks for the shareholders of the Company to pride themselves on, we do believe that it was a wise proceeding on the part of the directors to attach a new name to the Company, and we shall therefore be glad to see it prosper under new auspices.

The Lighting of Public Thoroughfares.—The Engineer to the Commissioners of Sewers says:—"For public thoroughfares, uniform distribution of light, generally speaking, best meets the public requirements, and this can be most successfully obtained by many small lights at small distances apart. Powerful centres of light at long intervals apart give intense brightness with deep shadows in their immediate vicinity, and distribute the light very unequally over the areas assigned to them; tested by this principle the excess of light given by the electric lamps was much less valuable than might be supposed."

Electric Domestic Lighting.—If the electric light is ever to become popular it must, the *Building and Engineering Times* says, be adapted to the indoor and everyday needs of the mercantile community especially, to the wants of the home, and it must also be brought within the bounds of financial economy. To achieve these ends a fair opportunity offers in the City of London, where several of the leading electric light companies are now working their systems in competition with each other alike in point of excellence and of cost, and the opportunity thus afforded is made all the more valuable by the fact that a large body of the shopkeepers and merchants along the various routes are willing and anxious to have the new illuminant applied to their premises, and have memorialised the City Commission of Sewers to that effect. It has been one of the salient statements of the electric light companies that they could split up their supply into sufficient detail to furnish illumination for domestic lighting; they apparently longed for the opportunity of doing so, and they have on many occasions made attempts at this with isolated shops or warehouses. But the circumstances indicated above are such as have hitherto given no opportunity in London for the companies to show us what they can do efficiently and cheaply, and it is therefore a pity that delays and complications should be imported, as they have been, by the Commissioners, who elected that the petition from the merchants and traders should be referred back for further consideration. What we want is light; literally as regards illumination, and figuratively as to the capabilities of the companies, and it is a pity that obstructions should be created in any quarter.

Fire Risks from Electric Lighting.—The following form has been adopted by the fire underwriters of Baltimore, Md., to be placed upon policies when electric lights are introduced into premises: "Privilege granted to use the electric light in the within-mentioned premises, provided the assured holds a certificate and guarantee from the company wishing the light that the equipment is and shall be maintained according to the standard of the New York Board of Fire Underwriters."—*The New York Electrician.*

Edison's Electric Light.—We read in *La Lumière Electrique* that the Edison Electric Lighting Company is now making the necessary preparations to put up lamps of their system in Paris.

Up to the present they have only occupied themselves with orders for the fitting of their lamps received from different towns in Europe, among others, Amsterdam, Antwerp, Brussels, Berlin, Frankfort, Sarreguemines, Brünn in Moravia, Steier, Vienna, Milan, and Bologna. In the first of these towns a central station is now being established, intended to feed 2,000 lamps distributed in different parts of the town. In Antwerp, a sugar refinery is lighted by 200 lamps of this system. In Brussels, the Museum du Nord is also lighted in this way, and they are now occupied in opening for that town a central station. In Frankfort, there are two establishments, each burning 60 lamps. In Sarreguemines, 400 lamps are at work. In Brünn, the new theatre will be lighted by 900 lamps, and further orders are being given to the company. In Steier, near Linz, they have just arranged for 60 lamps, and in Vienna, three places of the same importance are now lighted by their system. Finally, in Milan, they have arranged to light up two places, and in Bologna a large mill will be supplied with their lights.

Besides supplying these places with the Edison lamps, a few others have been lighted by other companies, who made their arrangements direct with the inventor. Among these we may mention the lighting of a large cornmill, in Gillamont, Switzerland, of which we spoke in our number of June 24th (*See* Electrical Review of July 1st). We intend shortly to give a description of the works, where Mr. Edison's apparatus are manufactured, situated in Ivry, near Paris, and which are at present in full swing under the superintendence of Mr. Batchelor, the assistant of Mr. Edison, and who, with Mr. Otto A. Moses, organised last year his exhibition in the Palais de l'Industrie.

Electric Light in Salford.—After an installation of four years' standing which has given entire satisfaction and been entirely free from repairing expenses the firm of J. Bury, dyer and finisher, Salford, has made an addition of two of the British Electric Light Company's Gramme machines. The making-up room, which was formerly lit by 90 gas burners, rendering the atmosphere of the room very unpleasant during night-work, has been fitted with 60 incandescent lamps, which obviate the above inconvenience. In the room is fixed a regulator, which enables the foreman to put out any number of lights he requires. The dye house is illuminated by two Brockie arc lights, which enable the foreman to match his colours at night as well as in daylight. The whole of the arrangements were carried out by Messrs. H. Bury and G. Tyndall, Electric Light Engineers and Agents for the British Electric Light Company, Manchester.

Underground Electric Light Wires.—The *Athenæum* states that Professor Houston, of Philadelphia, reports, after a series of elaborate investigations, that wires for the electric light are in every way less liable to accident if placed in the earth than if placed overhead. The municipal authorities, therefore, of Chicago have determined that the wires for lighting their city shall be placed underground.

The Jablochkoff Electric Light.—The Thames Embankment and other places lighted from the station of the Jablochkoff Company have been temporarily bereft of the services of that effective and wonderfully reliable system owing to an accident to the steam engine. It was stated when the lamps went out on Monday evening last that two or three days must elapse before they could be again put in action.

New Electric Lamps.—At 374, Euston Road, N.W., is to be seen an arc electric lamp called the "Diamond." It is extremely simple and light, and its actuating mechanism appears likely to compare favourably with any at present known. As we could not gain much information concerning the object of the exhibit in the Euston Road, not even to the extent of the inventor's name, we do not now propose to do more than merely allude to it.

We have recently had an opportunity of seeing in action

the arc lamps of Messrs. F. M. Rogers and Jarman, and also the dynamo-electric machine of the latter. We cannot yet describe them, as certain matters connected with the patents are not quite settled. The main objects aimed at, as far as both machine and lamps are concerned, has been to simplify their construction, and so produce them at a lower rate than is now paid for these articles.

Mr. Jarman is, we believe, now experimenting on an incandescent lamp devised by himself, so that it is shortly expected that the above-named inventors will have a complete system on view. We shall reserve all criticisms on the points involved in the respective lamps and machine for a future occasion.

THE ELECTRIC LIGHTING BILL.—In the Parliamentary discussion on this Bill, Colonel Makins asserted his belief that of the aggregate capital of £13,000,000 or £14,000,000 raised by the 55 electric lighting companies registered lately, the greater proportion had been expended on inventors and promoters.

ELECTRIC LIGHT SHARES.—Various statements have been put forth to account for the late rapid fall in Brush and Hammond electric light shares. One was to the effect that it is in consequence of the insecurity of the patent rights of the Brush apparatus. In the money market article of the *Standard* of last Wednesday, it says that the fall is due to the results disclosed at the meeting of the Brush Company. It appears that the available balance in hand is £245,000, which would be sufficient to enable a return of the paid-up capital, instead of half as much more as the market had anticipated. Can it be that the rules and regulations concerning fire risks from the electric light, issued by the Society of Telegraph Engineers and of Electricians, explain it? Rule 20 reads in part:—There should never be a difference of potential of more than 200 *volts* between any two points in the same room.

THE ELECTRIC LIGHT IN THE CITY.—At the fortnightly meeting of the Commissioners of Sewers held last Tuesday, Mr. Pannell presented a report from the Streets Committee relative to the Edison electric light on the Holborn Viaduct, and stating that they have arranged for the same to be continued for a further period of six months at the cost of gas.

The report was adopted.

Mr. Bedford said there was a magnificent light on the Holborn Viaduct, close to St. Andrew's Church. He wished to know if the engineer could give him any information on the subject?

The engineer said he supposed it was some recent experiment, but it had not been notified to him.

The clerk (Mr. Blake) read the report of the Streets Committee, which has been printed and circulated, on their proceedings relative to the applications made for an extension of the experiments in electric lighting; submitting an abstract of tenders received, and expressing an opinion that it is not desirable to proceed further until Parliament has decided the principle upon which electric lighting generally shall be permitted.

Mr. Innes thereupon moved, "That the report be referred back, with instructions to forthwith carry out the electric lighting through the tendering companies, with the light of private lighting in the districts for three years added to their contracts, reporting in the first instance on the cost of the street lighting after tenders have been made on the footing of the right of private lighting." He traced the action of the commission in connection with the electric light from the commencement, and urged that something definite should now be done. They were told that this was a speculation, but every improvement was a speculation in the first instance. The right of private lighting had been practically conceded in the case of the Edison company, who had commenced operations on the Holborn Viaduct. The other companies meantime were handicapped. They were told to wait for legislative action, but no legislation was required. He was averse to the commission making experiments, but contented that power should be given to the companies to make experiments without further delay. The divisions in the committee would prevent them coming to any decision, and he therefore thought the subject should be settled by the commission.

Mr. Morrison seconded the motion.

Mr. Shooter opposed the amendment, trusting that the commission would agree with the committee in their report. A discussion ensued, in the course of which Mr. W. J. Scott twitted the commission with trying to obstruct electric lighting. He had no hesitation in saying that the opposition to the amendment came from gas company interest. Mr. Shaw denied that there was any truth in the accusation made by the previous speaker; and as for the commission being obstructives, he pointed out that they had been the first to give an opportunity for experiments being made with the new light. The discussion was continued by Mr. Waller, Mr. Ashby, and several other members, and eventually the amendment was lost upon a show of hands being taken. A division was demanded, and the numbers were—for the amendment, 6; against, 17. The original motion to agree with the committee in their report was then agreed to, and after transacting some other business the commission adjourned.

INCANDESCENT ELECTRIC LAMPS.—A preliminary announcement emanating from the London and Provincial Electric Light and Power Company, to the effect that a limited company is now in course of formation for supplying Kensington, Hammersmith, Notting Hill, and other districts with the electric light by means of the Chertemps arc and British incandescent lamps, speaks thus of the latter: "The signal success which has attended the lighting of Stafford House by these incandescent lamps points to this as the most complete system."

THE "MORNA" CABLE STEAMER.—We read the following in the *Oban Telegraph* of the 14th inst.:—

The ss. *Morna*, of Leith, commanded by Capt. Howling, arrived here on Tuesday morning on her way to repair the broken cable between Oban and Mull. This steamer is fitted up with all the necessary appliances, and, in addition to the crew, there are thirty cable men and a large staff of electricians on board. On Tuesday afternoon the injured cable was tested, and the fracture found to exist in the vicinity of the Lady Rock. After completing the repairs on the Mull cable, the *Morna* proceeds to Yell Sound, in Shetland, for a similar purpose.

With reference to the fracture on the Mull cable, it may be stated that on examination it was discovered that the cable had been maliciously cut, in all probability by the crew of some vessel whose anchor had fouled, and, in order to save some slight delay in clearing the submarine line, a process easily accomplished. In view of the serious consequences to the country in expense and inconvenience, this must be looked upon as a most aggravated offence, and one deserving of heavy punishment. The cable was thoroughly repaired yesterday, and telegraphic communication resumed. The operations, which have been so speedily and successfully accomplished, were under the supervision of Mr. David Lumsden, Mr. Albrow, and Captain Hayward, electricians of the Submarine Department G. P. O., while Mr. Wright, the energetic local superintendent, lent intelligent and useful aid in shore work. Captain Howling, the commander of the *Morna*, is a most experienced navigator, whose skilful handling of his vessel greatly facilitates the progress of the work for which the steamer has been chartered. From later information we find that the cable in Yell Sound was made good on the afternoon of Tuesday last.

THE TELEGRAPH STEAMER "INTERNATIONAL."—The India-Rubber, Gutta-Percha, and Telegraph Works Company received on the 18th inst. a telegram from Mr. Theophilus Smith, engineer-in-charge, informing them of the successful completion of the repairs of the Havana-Key West Cable, for which the *International* had been chartered by the International Ocean Telegraph Company of New York. After coaling and provisioning the *International* leaves Key West for London.

NEW ZEALAND TELEGRAPHS.—The business of the New Zealand Telegraph Department during the quarter ending December, 1881, showed a satisfactory increase on that transacted during the corresponding quarter of 1880, the total number of paid messages for the former being 308,462—value £20,404—and for the latter, 263,908—value £17,188. The increase of messages was thus 44,554, and of receipts, £3,216. The Government telegrams numbered 51,734, the value being £5,654, or a decrease in number of 10,514 and in value of £1,140 on the December quarter of 1880.

A NEW METHOD OF TELEGRAPH TRANSLATION.—Sir James Anderson and Mr. Benjamin Smith, of the Eastern Telegraph Company, have introduced a system of personal translation by means of which the dispatch of messages is facilitated, delay avoided, and greater accuracy obtained. At present, as is well known, messages are written down by a clerk as they are received at the end of each section, and then passed on to another clerk, who transmits them over

the next section, and so on till the messages reach their destination. The new method is to cause the clerk who receives the messages, say from section A, to send them at the same time over section B, so that while he is reading the messages from the receiver he is transmitting them to the next relay. The advantages of this system are obvious. There is no writing down of the messages at the relay stations, and passing on to other clerks; the whole of the attention of the operators can be given to the receipt and transmission of the messages, and greater accuracy thereby attained. Where simplex is worked one clerk will take the place of two, and where duplex is in operation two men will in several instances replace six. The saving thus effected in the expense of the *personnel*, stationery, and apparatus will not be inconsiderable. We understand the system has already been adopted on the submarine lines of the Eastern, Eastern Extension, and South African Telegraph Companies.

THE PROPOSED ATLANTIC CABLES. — The *Illustrated London News* of Saturday last thus comments on the proposed Atlantic cables :—"Yet further competition is in store for the owners of the Atlantic telegraph cables. The controllers of the Baltimore and Ohio Railroad have decided to lay two cables across the Atlantic, one to England and the other to Portugal. It is surprising how the money is found for such enterprises, as of the many cables which have been laid for competing purposes not one has long remained outside, and all are now either owned by the original company or worked in unison with it; while every £100 spent in laying such cables speedily comes to be very much less than that. The result has so far been that the public has not derived the advantages usually following competition, while stockholders have lost in both capital and income from the excessive number of cables employed in the service. The fruit of this experience is that some degree of monopoly is desirable in the case of cables. Concessions for terms of years have been granted to the companies serving most of the other routes, but the Atlantic is quite open. The public is as well and economically served on the monopoly routes as on the open. The capital sunk in the open is at a discount of 50 per cent., that in the busiest of the monopoly routes is at a premium. With these facts before them European investors must indeed be foolish if they provide any of the capital for the new cables."

TELEGRAPHIC COMMUNICATION WITH THE SUEZ CANAL.—It is said that the means of maintaining direct telegraphic communication with the Suez Canal are now under the consideration of Her Majesty's Government.

ELECTRICITY IN WARFARE.—We understand that concurrently with the field telegraph and electric light, the telephone is to be tried in the Egyptian campaign.

FORMS FOR TELEGRAMS.—At a meeting of the Greenock Chamber of Commerce, held on the 13th inst., it was stated that efforts had been made to induce the post-office authorities to introduce a larger telegram form than that now in use. The directors were now able to report that the postmaster-general had given instructions that telegrams will not hereafter require to be written on special forms but may be handed in on any sheet of paper; also that telegrams of an urgent nature will be transmitted at any hour during the night from the Greenock post-office to any office having night officials on payment of an extra charge of one shilling.

SECRECY OF TELEGRAMS.—Replying to Mr. Pulestown, in the House of Commons, on Thursday, the 13th inst., Mr. Fawcett said that the practice which had hitherto prevailed in the post-office was not to give up telegrams, except on the applications either of the sender or receiver. Some doubt, however, has arisen whether they had legal power thus to give up telegrams, and in view of this legal doubt he proposed in the Post-office Bill shortly to be introduced to insert a clause which would place telegrams, with regard to secrecy, in the same position that letters now were.

TELEPHONES IN ENGLAND.—It is well known that the telephonic industry in America has made enormous strides, while in England the matter has made but little progress, Now however that the granting of the licences for the formation of telephone exchanges has been decided upon by the Postmaster-General, there appears to be no reason why we should not soon be on level terms with our American cousins. The towns of England are comparatively such short distances apart, that we have unusual facilities from this fact alone. Again, the undulatory current is not claimed in this country, but it is the United States. Therefore we may soon expect to see England to the fore with the telephone.

THE TELEPHONE IN ALEXANDRIA.—The *Standard* correspondent, in a telegram dated Sunday last, says police-stations are now established in all parts of the town, and the Oriental Telephone Company are laying down wires to place them in connection with each other.

THE WORLD AND THE TELEPHONE MONOPOLY.—In its City Notes, the *World* says :—Another new Telephone Company is announced. We hope, at all events, it will supply something good and cheap, for the present monopolist in that line is anything but a satisfactory servant to the public. Complaints are incessant, either that its instruments tell too much, lets those hear secrets who should not hear them, or that they will not work at all.

THE TELEPHONE IN SCOTLAND.—The National Telephone Company (Limited) have established telephone communication between Newport, Fife, and their exchange in Dundee. A wire is led across the standing portions of the Tay Bridge, and in the gap an 8-wire cable has been laid. From the south end of the bridge the wire is carried along the public road to the village. In Newport an exchange will be opened, the subscribers to which will, in addition to the convenience of conversing with each other, have the advantage of speaking to any subscriber to the company's Dundee exchange. The exchange at Newport will be open from 6.30 a.m. to 11 p.m. Several subscribers have already been obtained. Tayport is to be similarly treated. The National Telephone Company are to supply the contractors for the new Tay Bridge with telephone communication between the works on the one side of the river and those on the other side.

TELEPHONE SHARES.—It might almost be supposed that the decision of the Postmaster-General in regard to telephone licences had leaked out before his statement in Parliament, as on the preceding day the shares of the United Telephone Company fell £1 per share. Altogether they have fallen recently from 16 to 10¾; but the last quotation, on the 19th inst., was 11¼—11¾.

THE LIBRARY OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—Mr. A. J. Frost has just succeeded in acquiring for the Library of the Society of Telegraph Engineers and of Electricians a copy of the fine work Vincentius (Belloracensis), "Speculum Naturale," 2 vols. folio, 1473-76. Vincentius was Bishop of Beauvais, and wrote about the year 1250, and the work now referred to contains probably the earliest *printed* allusion to the polarity of the magnetised needle and its use in navigation. As a specimen of typography alone, independent of its literary interest, it is well worth a visit to the library, and we consider that Mr. Frost has been fortunate in obtaining this interesting and valuable work as an addition to the already important collection under his care. In these days of business activity such collections are apt to be forgotten or overlooked, and it is gratifying to feel that some one is giving attention to the completion of such important collections as those possessed by the society and Mr. Latimer Clark, and which cannot fail in the future to increase in value and interest. While referring to the library of the society we may add that an important and most complete list of works on electric lighting will be found in Kuhn's "Handbuch der angewandten Elektricitätslehre." 8vo. Leipzig. 1866.

THE AWARDS AT THE CRYSTAL PALACE EXHIBITION.—In our correspondence columns will be found a letter referring to these awards, and as we are frequently asked when they

are to be made we should be glad if any of our readers can give information on the subject. Surely sufficient time has elapsed. Perhaps the Honorary Council of Advice will give a little consideration to this matter.

THE ELECTRICAL INSULATOR MANUFACTURING COMPANY.—The operations of this company form a district branch of electrical work, but whether such a business will be of a sufficiently wide nature to justify the company's belief remains to be seen. There are certain statements contained in the prospectus which we feel called upon to challenge. In regard to the manufacture of insulators for home consumption we believe the postal authorities are almost the only people who require insulators, and these, we believe, are supplied mainly by one firm only. The supply required by the railway companies is but small, as they are generally only wanted for maintenance purposes. Telephone wires will probably soon be wholly laid underground. Therefore we think that the glowing statements of the promoters concerning the enormous business to be done at home in insulators must be taken *cum grano salis*. The scientific reports on the superior nature of this clay are not altogether in accordance with facts—that is to say, the importance of a material free from iron so far as insulators are concerned is much exaggerated. We believe that the several well-known firms of insulator manufacturers are quite equal, with their long experience, to supply a very largely increased demand at any moment they might be called upon to do so. We notice that the company purposes manufacturing other goods beyond those of an electrical nature; but the title of the company and the wording of the prospectus naturally seem to point to the conclusion that it is promoted to take advantage of the present electrical craze. We do not, however, consider that the statements with regard to the company's connection with the electrical industry are by any means exact.

A NEW ELECTRIC MOTOR.—M. Paul Jablochkoff, of electric light celebrity, has paid a recent visit to London. During his stay he submitted to some of his scientific friends a new electric motor, which possesses all the merits which characterise M. Jablochkoff's inventions—viz., extreme simplicity. If what we hear is confirmed, distribution of power by this new motor will become practicable at rates which would hardly have been thought possible by any of the means at present known. We need hardly add that this invention becomes, as a matter of course, the property of the newly-formed company bearing M. Jablochkoff's name. We believe that we are correct in stating that the firm of M. Breguet will work the French patent for this new motor.

PERSONAL.—Mr. Johnston, the well-known editor and proprietor of the New York *Operator*, has recently been visiting London. This is the first time we have had the pleasure of meeting Mr. Johnston, and we can fully endorse from our personal experience the opinions previously formed of his frank and humorous nature, which is so apparent in his writings. Mr. Johnston is not a stranger to London, and his first experiences in electrical matters were gained in the mother country. We trust that his trip will be throughout of an enjoyable kind, and that on his return he may reap still further benefit from the journal he has so long successfully and ably conducted.

TO ELECTRIC WORKS COMPANIES.—It may be of service to some of the new companies to direct their attention to the advertisement for the sale of premises and plant suitable for such works, particulars of which are given on one of our supplementary pages.

THE INTERNATIONAL ELECTRIC AND GAS EXHIBITION.—This proposed exhibition at the Crystal Palace is to commence in October next, and continue till the end of Easter week, 1883. Intending applicants for space should apply before the 1st of August. A limited amount of engine-power will be supplied, as far as it goes, to exhibitors desirous of taking advantage of this offer. Applications must, however, be made before the above date. Whatever work may be necessary to place and decorate exhibits must be done by the exhibitors at their sole expense, and always subject to the supervision and approval of the directors. We should imagine that as far as those connected with electric lighting are concerned, their thoughts will turn more in the direction of doing successful work during the forthcoming winter and paying dividends on capital employed. Exhibitions are very well from scientific or commercial points of view once in awhile; but it is possible to have too much of a good thing. That just closed at the Crystal Palace answered its purpose; but those exhibitors fortunate enough to float companies on the strength of their efforts in this direction will not, we should imagine, feel inclined to face a second heavy expense in so short a time, but will rather devote all their energies to the formation of a good and profitable business.

EXHIBITION OF PRACTICAL ELECTRIC DEVELOPMENT.—It is preposed to devote the buildings and premises of the Royal Aquarium, at Westminster, to the above purpose, from November 1st next to March 1st, 1883. It is instituted for the purpose of practically developing subsidiary points in the economical use of electric energy. Prizes are to be given for eighteen different subjects, and amongst them may be named:—The best systems of storage and generator for railway trains; the best systems of storage batteries; the best electro-motor for stationary or tram-car work: (*a*), absorbing ½ horse-power; (*b*), 2½ horse-power; (*c*), 5 horse-power. The best system of dynamos for compensating change in resistance of external circuit, &c.; the best electric meter; the best system of street mains or leads; the best photometer, and various other matters. The electric engineer to the proposed exhibition is Mr. W. D. Gooch, of 17, Royal Exchange, London.

TO OUR READERS.—We beg to inform our friends and subscribers that Vol. X. of the ELECTRICAL REVIEW can now be had handsomely bound, by applying to Messrs. Haughton & Co., 10, Paternoster Row, E.C. Cases for binding can also be obtained. For particulars see advertisement on page 11 of supplement.

TO MEDALLISTS OF THE PARIS ELECTRICAL EXHIBITION.—Electrotypes of the Paris medal may be had for the purpose of insertion in advertisements and trade circulars, &c., at moderate rates, on application to the manager of the ELECTRICAL REVIEW, 22, Paternoster Row, E.C.

NEW COMPANIES REGISTERED.

WEST MIDDLESEX ELECTRIC LIGHTING COMPANY (LIMITED).—Capital £100,000, in £5 shares. Office, 14, King Street, West Hammersmith. Objects: To purchase a licence acquired by Charles Cordingley from the British Electric Light Company (Limited), for the use of the Gramme dynamo machines, the British incandescent lamp, and Brockie's arc lamp. The purchase consideration is £12,500 in cash and £12,500 in fully paid shares. Signatories: J. H. Swann, C.E., 110, Cannon Street, 20 shares; W. J. Colley, Mill Hill, N.W., 20 shares; C. J. Parker, Hammersmith Road, 20 shares; J. Barnes, Hammersmith Road, one share; F. Wingrove, Hammersmith Road, one share; W. Pickersgill, 87, Arlington Road, Regent's Park, 10 shares; G. H. Hutchinson, 1, Laurence Pountney Hill, E.C., one share. Directing qualification, 20 shares; the signatories nominate the first directors. Remuneration, £1,000 per annum. Registered 13th inst. by Watson, Son, and Room, 12, Bouverie Street, E.C.

ELECTRICAL INSULATOR MANUFACTURING COMPANY (LIMITED).—Capital £100,000, in £1 shares. Objects: To carry on business as potters and manufacturers of electrical insulators in any material and of every kind. Signatories (with one share each): R. Marsh, 79, York Road, Lambeth; C. Bate, 78, Alexand Road, South Hampstead; C. E. Hewitt, 10, Thornsett Road, Anerley; T. J. Bradfield, 193, Clapham Park Road; E. H. Wilson, 10, Buckingham Street, Strand; J. Evans, 2, Crogsland Road, Haverstock Hill; S. H. Barlow, 38, Warbeck Road, Shepherd's Bush. Directing qualification, 100 shares; remuneration, £500 per annum, with an additional £250 after 10 per cent. per annum dividend has been paid. Registered 13th inst. by Pyke and Minchin, 31, Lombard Street.

NEW PATENTS—1882.

3171. "Governing marine engines by electricity." W. W. GIRDWOOD. Dated July 5.

3172. "Voltaic batteries." J. IMRAY. (Communicated by P. Jablochkoff.) Dated July 5.

3173. "A new or improved apparatus for recording speech." J. IMRAY. (Communicated by A. Gentilli and L. C. Alexander.) Dated July 5.

3175. "Improvements in the materials for and in the construction of electric insulating apparatus and in the means of preserving the same." W. F. BOTTOMLEY, J. H. BARRY, and J. J. LUNDY. Dated July 5.

3181. "Dynamo-electric machines." A. LÉVY. (Communicated by D. Lachaussée.) Dated July 5.

3190. "Electric and other tell-tales for indicating and registering." A. SCHWEITZER and T. LAWRIE. Dated July 6.

3204. "Apparatus for the generation, regulation, and utilisation of electric currents." W. R. LAKE. (Communicated by G. Thomson.) Dated July 6.

3217. "Machinery or apparatus for applying anti-induction coverings to insulated electrical conducting wires." G. S. PAGE. (Communicated by J. M. Stearns.) Dated July 7.

3219. "Supports for underground electrical conductors and their conduits." G. S. PAGE. (Communicated by J. M. Stearns.) Dated July 7.

3221. "Secondary batteries or accumulators." R. H. WOODLEY and H. F. JOEL. Dated July 7.

3226. "An improved electro-magnetic motor." E. TOYNBEE. Dated July 7.

3233. "Electric clocks." J. P. A. SCHLAEFLI. Dated July 7.

3236. "Arc electric lamps." F. M. ROGERS. Dated July 7.

3240. "Manufacture and preparation of plates for electric accumulators." T. S. SARNEY and J. M. ALPROVIDGE. Dated July 8.

3244. "Incandescing electric lamps." T. J. HANDFORD. (Communicated by C. A. van Cleve.) Dated July 8.

3255. "Improvements in the construction of incandescent electric lamps and in apparatus therefor, which apparatus is also applicable for other like uses." J. H. GARDINER. Dated July 8.

3263. "'Blocks' or 'cylinders' for incandescent lights." G. DAVIES. Dated July 10.

3271. "Electrical meters." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated July 10.

3273. "Magnets." J. S. FAIRFAX. Dated July 10.

3279. "Electric lamps." J. S. BEEMAN. Dated July 11.

3281. "Arrangement and application of electrical conductors." F. JACOB. Dated July 11.

3296. "An improvement in preparing the sheet lead electrodes of secondary batteries with a view to their rapid formation." A. M. CLARK. (Communicated by G. Planté.) Dated July 11.

3303. "Secondary voltaic batteries." F. W. DURHAM and P. WARD. Dated July 12.

3315. "An improved method and process of and apparatus for coating or covering wire with copper or other metal (telegraph wire)." W. R. LAKE. (Communicated by T. Wallace.) Dated July 12. (*Complete.*)

3318. "Improved means and appliances or apparatus for producing or evolving, collecting, storing, and utilising electric energy for lighting and for general purposes, partly applicable for use in combination with coal gas." J. L. PULVERMACHER. Dated July 12.

3322. "Apparatus for producing, measuring, and distributing electric currents." J. M. M. MUNRO. Dated July 13.

3330. "Electric lighting and power distributing systems." S. PITT. (Communicated by E. T. Starr and W. J. Peyton.) Dated July 13. (*Complete.*)

3331. "Improved apparatus for making and breaking electric circuits." J. R. GIBSON. Dated July 13.

3334. "Improvements in the construction of dynamo-electric or magneto-electric and electro-dynamic machines and in governing or regulating the same." R. MATTHEWS. Dated July 14.

3335. "Telephones." S. M. YEATES. Dated July 14.

3339. "Arc regulator lamps." R. E. B. CROMPTON. Dated July 14.

3349. "Incandescent electric lamp appliances." J. S. BEEMAN. Dated July 14.

3350. "Electric lampholders and switches therefor, or for other purposes." J. S. BEEMAN. Dated July 14.

3351. "Improvements in apparatus for automatically shunting electric currents, and in apparatus for breaking circuits." J. S. BEEMAN. Dated July 14.

3355. "Means or apparatus employed in or for supplying electricity for light power and other purposes." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated July 14.

3370. "Apparatus for automatically indicating the presence of fire or heat by electricity." E. EDWARDS. (Communicated by B. Carré.) Dated July 15.

3380. "An electrical haulage system and apparatus connected therewith." W. E. AYRTON and J. PERRY. Dated July 17.

3382. "Electric light appliances." H. J. HADDAN. (Communicated by G. H. A. Seymour.) Dated July 17.

3385. "A new or improved electric arc lamp." L. A. GROTH. (Communicated by C. P. Jürgensen.) Dated July 17.

3391. "Improvements in the manufacture of wire and in the apparatus employed therein." T. MORGAN. (Communicated by E. J. Levavasseur.) Dated July 17.

3393. "Electric lamps." J. D. F. ANDREWS. Dated July 17.

3409. "Plates for secondary batteries." W. TAYLOR and F. KING. Dated July 18.

3414. "Electric telegraph signalling apparatus." H. E. NEWTON. (Communicated by O. Zadig.) Dated July 18.

3418. "Improvements in electric arc lamps and in regulators therefor; applicable also to regulating electric currents for other purposes." S. Z. DE FERRANTI and A. THOMPSON. Dated July 18.

3419. "Dynamo electric machines or electric generators." S. Z. DE FERRANTI and A. THOMPSON. Dated July 18.

3420. "Dynamo-electric machines." W. P. THOMPSON. (Communicated by P. Payen and A. Sandron.) Dated July 18.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

4780. "Insulating electric conductors, &c." A. T. WOODWARD. Dated November 1. 6d. Relates to the mode of rendering the whole of the conductors and the test boxes entirely water and air proof, so that the insulation cannot be injured by moisture, and access can be had to the wires when required for the purpose of testing the same, and for taking off any lateral connections. Fig. 1 is a vertical section of the insulated telegraph conductors at two of the test or connection boxes, and fig. 2 is a cross section, at the line, *x*, *x*. The case or tube into which the electric conductors are laid is to be of any desired size or shape, according to the number of conductors it is to contain, and it is preferably of wood, but may be of metal or

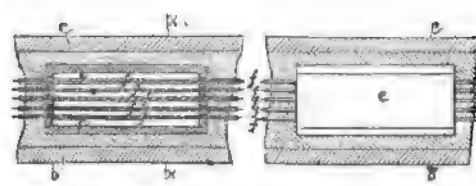


FIG. 1.

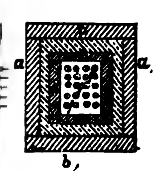


FIG 2.

earthenware. Such a box is shown as square sectionally, with sides, *a*, bottom, *b*, and movable top, *c*. There is introduced into the bottom of the case, *a*, *b*, *c*, a layer of waterproof insulating material, such as hereafter described, or any other suitable bituminous or water-proof compound may be employed. At suitable distances apart there are testing, or connection boxes, *e*, introduced within the case, *a*, *b*, *c*, and the wires, or conductors, *f*, *f*, pass through holes at the ends of these boxes. The water-proof insulating material is introduced in a melted state into the case, *a*, *b*, around the electric conductors, and also entirely around the testing or connection boxes, *e*. In applying the water-proof insulating material it is preferable to introduce a layer on the bottom of the case, then place thereon the lowest range of parallel conductors, then another layer of waterproof insulating material, and another range of parallel wires, and so on. The water-proof insulating material flows all round the testing or connection boxes, and hermetically seals the same, and renders the box perfectly water and air tight. Where there are lateral connections they will usually be made before the cover of the box, *e*, is applied, but when these lateral connections have to be made to a previously laid cable the cover of the external case is removed, and the water-proofing material at the testing-box is removed, the insulating material broken up, and the cover of the testing-box removed, to give access to the electric conductors for testing or making lateral connections, after which the box is closed and hermetically sealed by the melted insulating material. The water-proof and insulating material which it is preferred to employ is prepared as next described. The inventor makes use of silica, such as glass, or quartz, in the form of a very fine powder, and vegetable or mineral resin or pitch. This latter substance should also be ground fine and thoroughly mixed with the silica, and there is added to the same wax, such as paraffine, beeswax, or spermaceti, and also oil, such as boiled or raw linseed oil. It is preferred to use about 66 parts by weight of silica to 34 parts of resin or pitch, and 26 parts of wax, more or less, and about three parts of oil. These are all thoroughly combined in the presence of sufficient heat to liquefy the resin; the mass is to be carefully and thoroughly stirred to render it homogeneous.

5185. "Electric lamps." E. G. BREWER. (A communication from abroad by A. G. Waterhouse, of New York.) Dated November 28. 1s. Relates to electric lamps of the type in which carbon sticks or pencils are fed towards one another as they consume, the movement being controlled by a clutch or by wheel work, or by other suitable means, the action of which is governed by an electro-magnet or magnets. This invention consists, first, of certain novel con-

structions and arrangements of governing electro-magnets, of improved clutch or clamp devices for governing the descent of the carbon rod, and of a novel safety shunting device. Fig. 1 is a side view of a lamp having one arrangement of the electro-magnets, and showing also the safety shunting device. Fig. 2 is a top view of the electro-magnets partially in section. Figs. 3, 4, and 5 illustrate the clutches which are actuated by the movable electro-magnet. Fig. 6 is a detail of construction of the lamp illustrated in fig. 1. Figs. 7, 8, 9, and 10 illustrate modifications. Referring to figs. 1 and 2, A represents the base plate of a lamp upon which the enclosing

FIG 1

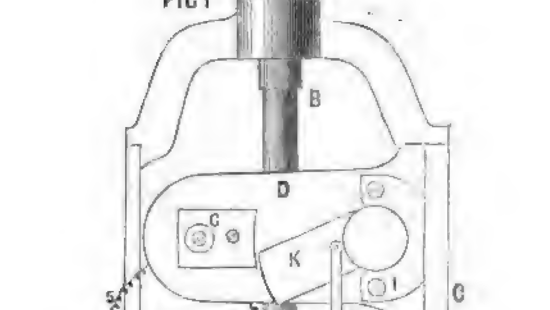


FIG 2

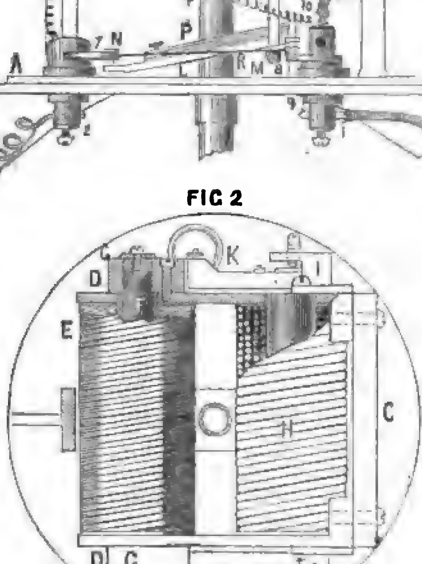


FIG 5

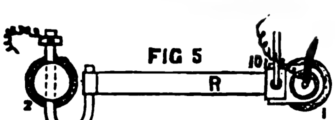


FIG 3

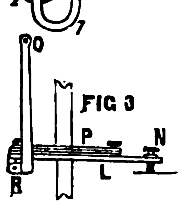


FIG 4

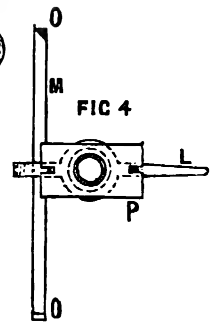
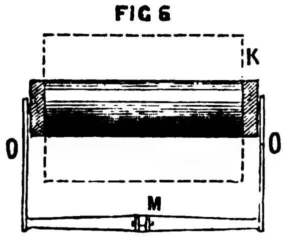
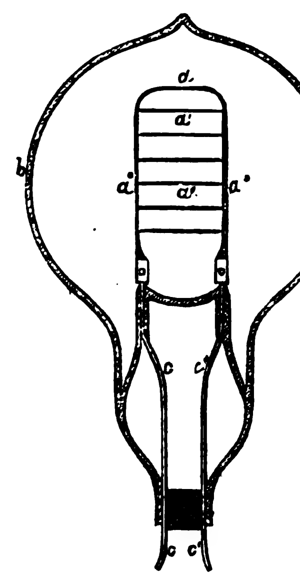


FIG 6



frame and the supporting standards for the operating portions of the lamp are mounted; B represents the carbon rod or carrier; C is an upright plate secured to base, A, and having bolted to it brackets, D, D, in which the electro-magnets are supported; E represents an electro-magnet wound with coils of comparatively fine wire, which are included in a derived or branch circuit around the arc. The core of said electro-magnet is represented at F as supported in the bracket, D. G, G, are pole pieces connected to said core upon the outside of the bracket, and extending at right angles from the core towards the projecting pole pieces of a similar electro-magnet, H, wound with coarser wire, and with its coils in direct circuit with the carbons and the arc. The core of the latter electro-magnet is pivoted from brackets or clips, I, I, secured to brackets, D, by screws or other means, and is provided with rectangular pole extensions, K, K, projecting towards the pole pieces, G, G, and adapted to swing in close proximity to the latter, as indicated in fig. 1. The coils of magnets, H, E, are so wound and connected to the general circuit that the pole pieces G, K, in proximity to one another would be naturally of the same polarity, so that they would repel one another. The action or influence of the main circuit coil, H, is however sufficiently strong to overbalance the opposing influence of the coils of E, so as to cause the core of E to be polarised by induction from the core of H, so that when the lamp is working there is a positive attraction between the poles. When however the length of arc increases so as to cause more current to circulate in the derived circuit coils, E, the latter exerts a greater depolarising influence, and thus causes a diminution in the attraction between the poles so as to allow the poles, K, to drop away, and through any suitable means to release the carbons and allow it to feed. The means here shown consist of a clutch engaging with the carbon rod or carrier, B; said clutch consists of a perforated lever, L, hung at one end from an arm, R, best seen in fig. 3, supported from a crossbar, M, and resting at the other end by means of a set screw, N, passing through it upon the base plate, A. The bar, M, is supported by links, O, hung from the movable pole pieces, K, as shown in fig. 6. The edges of the perforation in L, or in a series of superposed steel plates, P, supported on the plate, L, and to be presently described, is adapted to engage with the carbon rod, B, when the plate, L, is tilted, so as to stop the movement downward of the rod, or to lift the rod so as to establish the electric arc. As thus constructed the lamp operates as follows:—When no current is passing the pole pieces, K, and the supported clutch rest by the action of gravity or a spring in a position where the clutch, L, does not engage with rod, B. The carbons are then in contact. When the current passes, the poles, K, and G, are attracted owing to the preponderating effect of the current circulating in coils, H. The clutch is thus tilted and lifted, raising the carbon rod, B, and separating the carbons to a distance dependent upon the adjustment of the screw, N, or of a suitable retracting spring acting upon K. When the arc lengthens by reason of waste of the carbons, more current circulates in E, and its depolarising influence is increased, so that the attraction between K and G is diminished and the carbon rod is thereby released, so that the carbon feeds downward.

5233. "Utilisation of electricity for lighting, &c." W. R. LAKE. (A communication from abroad by J. S. Williams, of Paris.) Dated November 30. 1s. Relates to the utilisation of electricity for lighting or other purposes, and apparatus therefor or to be employed in connection therewith, also to the means for producing or manu-



facturing various parts of such apparatus. The figure is a centra section of one form of the improved lamp in which a conductor is employed having a series of transverse filaments. The invention also refers to electrical warming apparatus.

5261. "Secondary batteries." H. E. NEWTON. (A communication from abroad by Ernest Volckmar, of Paris.) Dated December 1. 6d. The object of this invention is to obtain secondary batteries which will give, with a minimum of weight and dimensions, the maximum of electrical energy. The improvements are as follows:—The inventor arranges a certain number of secondary couples in a single vessel. The plates are placed by preference horizontally one above the other. In this way there will be as many elements as there are plates, less one, each plate being at the same time the positive electrode of one couple and the negative electrode of the following couple, with the exception of the first and the last plates, which form the poles of the battery. The horizontal arrangement offers one peculiar advantage:—If one of the electrodes of this nature becomes disintegrated from any cause the disintegrated particles of a superior plate will fall on to the plate which is immediately below without causing the least disturbance, because these particles will unite themselves with the active matters of the support upon which they have fallen and identify themselves with them under the influence of the charging current.

5295. "Mechanism for regulating the feed of electrodes in electric lamps." H. E. NEWTON. (A communication from abroad by Alphonse Isidore Gravier, of Paris.) Dated December 3. 6d. Relates to the regulation of the electrodes in that class of electric lamps in which clockwork is employed, the object being to produce a more delicate regulation of the electrodes than has been heretofore obtained. For this purpose two electro-magnets are used to control the movements of an oscillating locking bar, which engages with the fly and scape wheel of the clock mechanism for the purpose of locking and releasing the same, and thus controlling its movements. The carbon electrode to be regulated is carried by a vertical rack-bar, which forms the propelling weight of the clock, and thus on the release of the scape wheel the feed of the carbon instantly commences. A tendency is given to this locking bar to drop into the locking position by the pressure of a light spring, a counterweight, or its equivalent. The electro-magnet situate on the weighted side of the locking bar is coiled with a comparatively thick wire and is set in the main circuit of the lamp. The office of this magnet, which is the more powerful one, is to draw forward the oscillating bar and retain it in its locking position. The electro-magnet on the opposite side of the locking bar is coiled with a fine wire to offer a greater resistance to the passage of a current than the coils of the more powerful magnet. The greater resistance magnet is placed in a secondary or derived circuit, one of its terminals being connected with a terminal of the other magnet. The effect of this arrangement is that when the arc has increased to such an extent as to offer an undue resistance to the passage of the current in the main circuit, an increased proportion of the current will pass to the derived circuit, thereby increasing the attractive power of the electro-magnet in that circuit to an extent that will enable it to pull over the locking bar, release the scape wheel, and set the clockwork in action. So soon as the resistance in the main circuit has decreased by the approach of the carbons, the electro-magnet in the circuit will regain its superior attraction and return the oscillating bar to its original position. Adjustable stops are provided for limiting the motions of the locking bar.

5303. "Telephones." ISAAC BURTON. Dated December 5. 2d. This invention consists in the construction and use of what the inventor calls an "anti-induction diaphragm" between the end of the telephone magnet and the metallic diaphragm at present in use in the instruments employed for telephonic communication, the object of the invention being to decrease the induction and thus to prevent the sound or voices from other wires being heard by the operator. The "anti-induction diaphragm" consists of a disc or discs of paper, parchment, papier maché, or other suitable material (of a smaller diameter than the ordinary metallic diaphragm) placed between the latter and the end of the telephone magnet. (*Provisional only.*)

5316. "Apparatus for lighting railway carriages, &c., by electricity." R. LAYBOURNE. Dated December 5. 6d. Relates to an improved arrangement and combination of apparatus employed for lighting railway and other carriages and trains by electricity. For this purpose the inventor mounts or affixes a dynamo-electric machine so that it may be driven by the wheels or axles of the engine, tender, or carriage of a train or other vehicle by means of bands or straps and pulleys, or by toothed wheels, or by friction pulleys actuated by the tyres of the wheels, or by other motive power carried thereon, the current of electricity derived from such dynamo-electric machine being employed to charge or maintain the force of a series of Faure's accumulator batteries (or any other suitable accumulator capable of storing electricity), such accumulator being carried by the train or carriage.

5322. "Electric accumulators." J. IMRAY. (A communication from abroad by Jules Carpentier and Dr. Oscar de Pezzer, both of Paris.) Dated December 6. 2d. In electric accumulators in which equal surfaces of lead are employed the negative plate has formed on it a suboxide such as Pb^2O and when this plate is fully oxidised there still remains on the positive plate a peroxide such as PbO^2 unreduced, and consequently useless. In order to lighten and simplify the accumulator its plates are, according to this invention, so proportioned in thickness and surface that useless material is avoided and more complete and uniform action is insured. For this purpose the negative plate, is made very thin and the positive plate has about twice the thickness and about half the surface area of the negative plate. Each plate, instead of being made in one piece, consists of a number of blades bent double and placed side by side within a porous cell of retangular shape, all the blades of a cell being soldered to a conducting wire or bar at the top. (*Provisional only.*)

5338. "Secondary batteries." DESMOND GERALD FITZGERALD, C. H. W. BIGGS and W. W. BEAUMONT. Dated December 6. 6d. Relates to the production of the plates or electrodes employed in secondary batteries. It is necessary that these plates should expose large surface to contact with the electrolyte, as for instance by being made porous or by multiple folding. One part of the invention consists in making these plates by drawing sheets of lead between two flat surfaces of wood or metal, one of which would have a reciprocating motion of small range, and be provided with a number of fixed points, such as pin or needle points, disposed in such a manner as to finely perforate the sheet of lead which would de drawn at the necessary speed between the two surfaces, so that the perforations should be closely contiguous. The points or punches may be disposed so as to occupy intersecting points made by lines drawn parallel to each other, and traversed by other parallel lines at a certain angle thereto. After perforation these plates are oxidised or chemically treated, so as to prevent metallic union when being mechanically manipulated, as herein further set forth. With this in view the inventors prefer to immerse the perforated plates in dilute sulphuric acid contained in a vessel from which air may be withdrawn, the object of this being to fill the perforations with a fluid capable of acting superficially upon the metal, so as to produce for instance a coating of lead sulphate within the perforations.

5360. "Telephone transmitters." E. H. JOHNSON. Dated December 7. 2d. According to this invention the inventor uses an electrode made from a metal of high specific resistance, such as tellurium, boron, or silicon in combination with a diaphragm, the primary wires of an induction coil and a cell of battery or other source of electric energy, which combination constitutes a telephone transmitter, possessing certain important and valuable advantages over other telephone transmitters. The inventor has found by experiment that when the metal used forms part of a low resistance circuit, a slight variation of pressure between it and an electrode of similar or dissimilar metal will produce a corresponding variation of the resistance of the circuit, and consequently a variable strength of electric energy sufficient to actuate the diaphragm of a telephone receiver, and that a variation quite sufficient for the purpose of transmission of speech so as to render it distinctly audible in the receiver may be had without producing an actual break of the circuit by a separation of the electrodes.

5385. "Telephones, &c." G. W. FOSTER. Dated December 9. 6d. Consists of a telephone handle or case furnished with an exterior groove or recess for the reception of a helix or coil, also with a hole for the reception of a magnet, and two holes bored at an angle for the reception of telephone cords. Also of a permanent magnet fashioned with a screw cut head and a fixed metallic screw cut adjustment collar, whereby said magnet can be fixed and adjusted to its proper position with reference to the diaphragm of a telephone. Also of a combined lightning arrester and binding post device, consisting of two or more metallic pieces arranged in a ring shape provided with threaded connections for holding the contact points of telephone cords, and suitably connected with the ends of the telephone or other helix, said metallic pieces being fashioned with teeth or corrugations on their surfaces and placed near to one another. Also of a telephone constructed of two metallic plates, each fashioned with a contact shoulder for receiving a diaphragm, and placed shoulder to shoulder for holding the diaphragm and forming an air chamber, said diaphragm being insulated from either or both of the plates, and said plates being provided with hinges and made to form a door or cover to a receptacle for holding an induction coil or other matters. The plates being used as conductors of electricity and to complete the primary circuit of the telephone. Also of a telephone transmitter consisting of a spiral spring fastened to a diaphragm at one end and a pin at the other, in combination with a suitable electrode held in a cap supported by a pressure spring, said spring being attached to an insulator by a screw at one end and to the cap at the other by a screw nut, together with a screw for governing the pressure of the electrode against the pin. Lastly, of the insulator for insulating the primary conducting wire from the inner metallic plate.

CITY NOTES.

OLD BROAD STREET.

SOUTH AFRICAN BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Monday last the first ordinary general meeting of the above company was held in Cannon Street Hotel, which was preceded by an extraordinary general meeting, held for the purpose of confirming a special resolution passed at a previous meeting of the company on June 19th last. Colonel George Coxon, chairman of the company, presided.

The secretary, Mr. Thomas J. Seel, having read the notice convening the meeting, the resolution, which was as follows, was taken as read:—

"That the articles of association be altered in manner following, that is to say:—

"The following article shall be substituted for article 71, viz.:—

"71.—The office of director shall be vacated—

"(1) If he become bankrupt, or liquidating debtor, or lunatic, or compound with his creditors.

"(2) If he ceases to hold the requisite share qualification.

"(3) If he absents himself from the meetings of the board, without leave of the board, for a period of three consecutive months at any time.

"Any director (whether an ordinary director or a managing director) who otherwise than as a member or director of an incorporated company, is concerned in or participates in the profits of any contract or transaction with the company, or is entitled to any interest in any property about to be purchased or taken on lease by the company, shall at or before the time when such contract, purchase, or transaction shall be entered into or agreed to on behalf of the company, disclose the nature and extent of his interest in any such intended contract, transaction, or property, and thereupon a memorandum to that effect shall be entered in the directors' minute book. In default of such disclosure being duly made when and as required (but not otherwise) a director shall be held to be a trustee for the company to the extent of any profit or emolument he may have or obtain under or by reason of any such contract or transaction, or by reason of any such purchase or lease, and if such director be the sole person interested in such contract or transaction, or in the property purchased, or taken on lease, the contract or transaction, or purchase, or lease may be set aside at the option of the company. A director who is concerned in or participates in the profits of any such contract or transaction, shall not vote in respect thereof, notwithstanding that his interest is merely that of a member or director of an incorporated company, or that he has duly declared his interest, and if he does so vote, his vote shall not be counted."

The Chairman stated that the sole object of the extraordinary meeting was to confirm the above resolution, and moved its confirmation in the usual terms.

Mr. C. E. Atkinson seconded the motion, which was put to the meeting and carried unanimously.

The Chairman: Gentlemen, that finishes the business of the extraordinary meeting. The second paragraph of your notice is with reference to the first general meeting of the company which I have now the honour to open. On the last occasion when we met there were certain queries put to us—rather prematurely we thought, considering the company was only just started—and we intimated that on this occasion we would be more prepared and ready to give any information with regard to the position, progress, operations, and prospects of the company than we were then prepared to do. In pursuance of that engagement, I will, with your permission, read you a few notes which I have made on the position of our company, because we consider ourselves, as representatives of the shareholders of this company, as custodians of their interests, and that therefore we hold we ought to have everything in common with them, and to retain nothing from them with which they should be made acquainted. Of course there are certain matters with regard to terms of contracts that you will understand, as men of business, it would be absurd to expect to be published; that it should not be published to the whole world any more than that any one of you in business would think it wise to publish his terms of contracts to the world. But any shareholder who wishes full information can have access to the books at any time, and Mr. Seel, our secretary, will be always glad to give any information to any shareholder who may wish for it. This company was registered on May 13th last, and it will be no doubt satisfactory to you if I say a few words with regard to its position and prospects. The shareholders will remember that in 1881 Messrs. Blane and Macdonald acquired from the Anglo-American Brush Electric Corporation, Limited, a licence to use in South Africa the Brush system of electric lighting. They sent to the Cape Mr. Donald Macdonald, now our Colonial manager, and also purchased and forwarded to South Africa some engines, dynamo machines, and plant. The company acquired from them not only the concession for the use of the Brush system, but also the plant in the colony and in transit and the benefit of the contracts under negotiations which had been opened or were in course of being arranged. The shareholders will be aware that a company starting new business such as ours will necessarily have to spend money in experiment and in temporary installations; and the negotiations which had made most progress at the time of the company's incorporation related to the lighting of Kimberley. So long ago as October last our manager reported that since his arrival he had seen several members of the Town Council on the subject of lighting the town, and from what had transpired there was every prospect of securing a good contract. From time to time he reported the progress made in the negotiations for the contract, and in January last he reported that he trusted soon to be able to state that a contract had been secured. I give you, gentlemen, merely extracts from his letters bearing upon this point, and all the extracts that I shall read are simply those that bear upon that point. The others refer to the general business of the company. In February he reported that experimental lights had been started, that is, in Kimberley, and that he was pushing on the final arrangements with the council. On the 2nd of March he reported that the lights had been going on steadily, and they had given general satisfaction, and he goes on to say that he was negotiating for their permanent installation, and that the difficulty—I beg to call your attention to this—which stood in the way of making the contract was that the lighting rate was not to exceed 1d. in the £, which was not sufficient to produce enough to provide sufficient remuneration for installing and working thirty-two lamps required to light the town. And it is an important fact that at that meeting an addition of £3,000 was made to the rates for the purpose of increasing the funds in hand for the lighting rate. That is, an additional £3,000 raised by the corporation with a view to lighting the town with electric light. The whole thing may have to be submitted again to the ratepayers. Later on in the same month Mr. Macdonald informed us that a meeting of ratepayers would immediately be called, and that he thought his final proposal would be accepted. On the 11th of May, two days before the company was registered, a telegram was received here; it ran as follows:—"Have made a contract for Kimberley." It was, therefore, very gratifying to the directors to be able to announce in their prospectus that a telegram had been received; that is, that the contract had been completed with the Mayor of the town of Kimberley to light the town with the Brush system on terms which the directors believed would prove highly remunerative. Our manager communicated to the directors the rate of the proposed contract as agreed to by the Town Council. The directors did not consider it would be advisable in the interests of the company to make public the terms of this contract. But they consider them satisfactory in all respects, and negotiations are still going on with every prospect of ultimate success. With reference to the Kimberley contract, the directors have to add that, although it has been approved, and the resolution to seal it signed by the Town Council, a minority of the ratepayers (the majority have voted in its favour), interested from other motives, are still endeavouring to prevent its being carried into effect, and have gone so far as to commence proceedings to restrain the council; that is, to restrain the Town Council, in the person of their mayor, from signing the contract, on the ground that the corporation, as at present constituted, is not a legal body because the voters' list for the present year has not been made up. With reference to this hitch our manager writes: "I am in no way anxious as to the result; but some further delay will be involved, as in all important cases appeal is made from the High Court of Griqualand West to the Supreme Court of Cape Town; and in the meantime the work has been proceeded with." New plant is on the way, and the work is being pushed on in order to complete the contract. The directors cannot but think that the public feeling in Kimberley will be too strong for the opposition, and that matters will go forward presently more smoothly than at present. Concurrently with these negotiations our manager, to whose zeal, untiring energy, and great ability, we hope one day to point as the chief factor in the success of the company, had been negotiating for the lighting of the Cape Town docks, harbour, and railway station, and has, we are happy to report, brought his negotiations to a successful issue. On May 2nd he writes with reference to the experimental installation in the Cape Town docks, the lamps have worked perfectly since I wrote on the 6th ult., and without interruption, "and that it was probable that he would be asked to submit an estimate for lighting the outskirts of the town," where the gas company, whose contract has been continued for another year, has refused to lay their mains, owing to the small number of lights required. On May 30 he wrote:—"Lights in the dock are giving every satisfaction, and I have reason to believe that they will be permanently established." Further on he adds: "Lights are working well in the dock over thirteen hours per night," but the Board have yet come to no decision. The engineer informs me that the only hesitation on the part of the commissioners is their want of perfect assurance that the Brush system is the best; but he has been able to satisfy them that it is the cheapest. That, I may say, is the government engineer, not our representative; and I think there is little doubt the light will be adopted. He adds: "The new company should, I think, work up incandescent lighting for uses which would open a larger field for lighting in all interior towns where gas is beyond reach. On the 9th of June he wrote that if the Kimberley mining board did not undertake the lighting of the mines, the company will certainly light their own works; and that it is from this source that he anticipates our chief business from the fields; but owing to the extreme depression now prevailing it may take some time to develop this branch of our business. Again he writes: "You will see from the copy of the *Port Elizabeth Herald* that permission has been obtained from the Town Council of the town to exhibit a set of lamps in the streets. Not very long ago the Port Elizabeth Council refused to have anything to say to the light—I suppose they like the look of it." In the same letter he intimates that he has addressed letters to the Government and Table Bay Harbour Board, stating that it is the intention of this company to establish in Cape Town a general electric business, and that they are prepared to enter into contracts for lights at fixed rates per light per annum, to be worked by our own men and at our own risk. On the 4th of this month we received the following satisfactory telegram, which comes well after these negotiations by our manager:—"Dock Railway agreed; sail to-day;" which points to the final conclusion with the dock and railway. "Sail to-day" means this: We thought as soon as our company was formed that there were a good many matters that could better be discussed personally with our manager—whose very extensive experience and knowledge of all the fields of future operations in the Cape are quite of exceptional value—that his presence here would be more satisfactory and would enable us to see our bearings a little better. Our manager spoke in one of the letters which I have read of the necessity of incandescent lighting. I refer back to that to explain this telegram, because, with reference to the extract of the letter of May 23rd, prior to the formation of this company, Mr. Alexander Macdonald, of Blane, Macdonald, and Company, had been granted the refusal of the patents for South Africa held by the Electric Storage and Force Company—the Sellon-Volckmar accumulator—on exceptionally favourable terms. I may add, what may not be generally known, that we may now say the Sellon-Volckmar and Faure accumulator, because this company has absorbed the patents of Mr. Faure as well as the well-known patents of Sellon and Volckmar. In fact, they cover now all the patents that can be applicable to what we may look upon as the groundwork of all future electrical operations. Our agent alludes to the question of lighting solely; but I need not tell you that the facilities for lighting given by this valuable accumulator are only a small part—certainly only a part—of the immense power and advantages we shall possess by holding this patent, in the matter of tramcars and force for machinery, in fact, force as well as light. The directors were enabled, through the good offices of Mr. Alexander Macdonald, to open negotiations with the Electric Storage Company, which resulted in acquiring these patents on the same favourable terms. They are exceptionally favourable, and we are very fortunate to be in the position to be able to tell you that we are, in so far as that goes, holders of exclusive rights of the Brush system and of the Sellon-Volckmar accumulator system, and so far, are masters of the situation. One matter in the course of ordinary business, and the only one that calls for our attention, is the confirmation of the appointment of Messrs. Deloitte and Dever as auditors of the company, which, therefore, I beg to propose.

Mr. Lloyd seconded the motion, which was carried unanimously.

The Chairman: That completes then our business at this meeting, and I am very much obliged for your attendance.

In reply to a shareholder, who asked whether it was the intention of the company to apply for a Stock Exchange quotation,

The Chairman said they had applied. They could not possibly get a quotation till this clause of the Articles of Association were altered, and it was in order to qualify them for this quotation that an extraordinary meeting had been called to-day.

On the motion of Mr. Edmund Hornsby, seconded by Mr. Dickson, a vote of thanks to the Chairman was carried by acclamation, to which the Chairman briefly responded, and the proceedings terminated.

THE ELECTRIC LIGHT AND POWER GENERATOR COMPANY, LIMITED.

An extraordinary general meeting of the shareholders of the above company was held on Friday, the 14th inst., at the company's offices, 47, Cannon Street, Admiral E. A. Inglefield presiding.

The secretary, Mr. F. H. Landon, read the notice convening the

meeting, which stated that the purpose of the meeting was to confirm the following special resolution which was duly passed at an extraordinary general meeting of the members of the company held on the 27th ultimo: "That the name of the company be changed to 'The Maxim-Weston Electric Company, Limited.'"

The Chairman said: That, gentlemen, is all the business before us to-day. Some little misapprehension, however, has arisen with regard to a paragraph, as printed, of my speech at the general meeting of the company, and I think this a favourable opportunity—I won't say of qualifying, but of explaining what I then said. I told you we were in negotiation for selling concessions to a very large amount, that we were also engaged about some very favourable contracts which we were very hopeful would yield large profits. I should like to qualify it by saying that it should be stated that the contracts are not quite independent in themselves; they were dependent upon one of the concessions in progress of negotiation, which he had previously mentioned. If the contracts, as well as the concessions, were completed, the contracts would be made over to the concessionaires under certain terms. If the concession were not carried out and the contracts were, the latter would be worked by this company on profitable terms. I think this misunderstanding it is desirable to correct. It is no actual alteration of the facts—but it must be understood that the contracts must be looked to first and the concessions afterwards; for if none of the concessions were carried the contracts could be worked, though, of course, in one case the profits of the company would be larger than in the other.

Mr. Russell asked what proceedings would be taken to make it clear that under the new name the company would still be the same?

The Chairman said that in contracts, and so on, the new name would be employed with the old name in brackets, so that there might be no misunderstanding. They required, he might add, permission from the Board of Trade before the shares could be issued under the new title. They expected that to be done within a fortnight. The Chairman, continuing, stated that they had at the Reading show, which was then taking place, an exhibition of their system, which was visited by 20,000 people. He might also read to the meeting, from a paper read by Mr. Sugg before the Gas Institute in June last, the following comparison of lights from tests made:—Jablochkoff system, 114 candles; Brush, 557; Weston, 1,466. To this latter figure the author added, "This is the most powerful light I have yet tested."

Colonel Gilbey said that statements had been made that the Brush was the cheapest system, but when they took into consideration the fact that this company's system supplied such a much greater illuminating power, they could claim economy as well as efficiency. He believed that wherever their lights were shown they extinguished everything else.

The Chairman said that that was all their business. He might just add that companies such as theirs were not to be judged by the market price of the shares. With all these mushroom companies—for he could not but think that many of them were mushroom companies—starting up around them, he could easily understand that people were a little perplexed as to what was to be the light of the future. He thought that their light would stand the test of any comparison. At Reading, where their exhibition took place, he believed that another company's exhibits—he would not mention its name—were quite thrown into the shade by the Weston lights.

In reply to Mr. Griffiths, the Chairman said that the new title would be impressed in the articles of association, and upon their prospectuses wherever their name occurred.

A vote of thanks to the Chairman was moved by Mr. G. Russell, seconded by Mr. Griffiths, and carried unanimously, and the proceedings then terminated.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

A SPECIAL meeting of the above company was held on Tuesday last in the City Terminus Hotel, Cannon Street, Sir Henry Tyler, M.P., chairman of the company, presiding. The secretary read the notice convening the meeting, which stated that the following resolution would be proposed: "That the 85th of the Articles of Association be repealed, and that in lieu thereof the following be henceforth the 85th of such articles:—'85. The directors may, from time to time, of their own authority, pay to the members in proportion to the amounts paid up, or credited as paid up, on the shares held by them respectively, such bonus and such interim dividends as in the judgment of the directors the position of the corporation justifies.'"

The Chairman said: We have asked you, gentlemen, to be good enough to meet us here to-day in order to get us out of a little difficulty. That difficulty is rather a serious one, and, as far as I am aware, it is an unprecedented one. But the fact is we have a good deal of money now, and we wish to distribute it amongst you, and we are unfortunately precluded by our articles of association from so distributing it. Now these articles of association are, of course, our law; we are entirely bound by them, and, it is only on our personal responsibility that we can depart from them. The amount we wish to distribute amongst you we have arrived at this morning after looking through all the figures of the company, so far as we are able to make them out at the present time. You are aware that under the 91st article, on page 29 of the Articles of Association, the true financial statement of the corporation and general balance-sheet are to be made out as on the 31st December, so far as the business of the corporation will admit, and should be laid before each ordinary general meeting after the first general meeting. So far, you see, we can only make our accounts and have our ordinary general meeting once a year. We have not thought it at all worth while to go through the process of taking stock, as we would have to do in making up our accounts at the end of each year, but we have prepared a rough balance-sheet to satisfy ourselves as to the amount which it is desirable to distribute, if you are good enough to give us permission to do so, and in that way we have arrived at the sum of £245,000 that we have to pay to you whenever you like to receive it, and we propose, with your permission, that it shall be paid to you in the middle of August. In order to do that we must alter Article 85 of the Articles of Association which says, "That the directors may on their own authority once in every year pay to the members a sum on account of the dividends not exceeding a rate of 10 per cent. on their respective shares." It is quite clear that the legal gentleman who drew that article, as well as the directors who sit before you, had no idea when this company was incorporated what success it was likely to meet with. (Hear, hear.) And therefore we were precluded by that, and we precluded ourselves, from paying more in the way of interim dividends than 10 per cent. per annum on the respective shares. That I take to be the meaning of this clause. Having, as you will see, the sum of £245,000 to distribute at present amongst you—and that, I may say, is entirely out of the profits in this undertaking—we are obliged to ask you to allow us to alter this article of association, and we have done so, merely repeating what was said in the previous article, that the entire net profits of the corporation shall belong to the holders of the shares of the corporation—I think you will admit that this is sound doctrine—and shall be divided among all the shares of the capital of the corporation for the time being issued and fully paid up, or deemed and taken as fully paid up; and in case of any of the shares not being fully paid up, then in respect to such shares in proportion to the amount of all calls then paid on such shares. Now, you will see in the resolution we have put before you to-day and in the individual article which we propose to alter, we have carried out the proposal as prescribed in the 84th article which I have just read to you, and therefore our resolution to-day is "that the directors may from time to time, on their own authority, pay to the directors in proportion to the amounts paid up or credited to be paid up"—the very words of the previous article—"on the shares held by them respectively, such bonuses and such interim dividends as in the judgment of the directors the position of the corporation justifies." We consider after having looked through the figures this morning that our position justifies our dividing amongst you this sum of £245,000, and we therefore recommend you to pass this resolution in order to enable us to distribute it amongst you about the middle of August. I beg to move the resolution I have just read.

Mr. Sellon said: Gentlemen, I beg to second the resolution which our chairman has so well put before you. He has fully explained to you the reasons which make it desirable that this resolution should be carried, and therefore it is quite unnecessary that I should amplify upon those reasons. I simply beg to second the resolution, and I hope it will be your pleasure to accept it.

Mr. Isaac said that if he understood rightly, the money which it was proposed to divide amongst the shareholders as a bonus had arisen from the sale of licences which had been given to other companies. He would suggest that instead of distributing the money as bonus it should be put to account as capital. That would make no difference as to the amount to be divided, but it would as to the nature of the payment itself. He did not think but that the fully paid up shares, and those in which only £4 had been paid up, would eventually become of the same value, and that they would be able to divide their dividends without the use of any capital at all. But if they divided this money as a bonus, the fully paid up shares and those on which £4 had been paid up would remain always at the same relative value. He would, therefore, propose that the money proposed to be distributed as a bonus should be distributed *pro rat*â on capital.

The Chairman: Do you move that, because that is hardly in order as an amendment? This is merely a proposition for the rejection of certain words in the Articles of Association and the substitution of others. I have not asked liberty to divide any money at all.

Mr. Isaac said he would put it in this form: "That the proposed resolution be modified to this extent, 'The directors may from time to time, of their own authority, pay to the members, in proportion to the amounts paid up or credited as paid up on the shares held by them respectively, such return of capital (instead of "such bonus and such interim dividends") as in the judgment of the directors the position of the corporation justifies.'"

Mr. Abbott said that as no one had risen to second the amendment it was a true estimate of the opinion of this meeting to say that they quite agreed with the resolution proposed. He himself quite agreed with the proposal of the Board for this reason, that the mover of the amendment was under a decidedly wrong impression in supposing that this company parted with any valuable portion of its property through having granted licences or concessions either in any part of this country or abroad. In these concessions—he should be glad to be corrected if he was wrong—all that they had parted with was the licence to develop the Brush system in various parts of Europe. At the same time they formed a very valuable adjunct, seeing that the company manufactured all the material which these subsidiary companies employed, and they had therefore in them a very valuable outlet for the commodity in which they dealt without any increase in their capital. So far as he understood it they were establishing really a goodwill on a going business, and a profitable goodwill which would rather increase the value of the capital which remained; but in order to still further increase it, it was desirable to have as large an addition to the reserve fund as possible. This alone would give them the command of the market among the electric light companies. He looked with very considerable jealousy on a proposal that the capital already subscribed should be returned, when it was in this company so very profitably employed. It had been the fashion of various companies from time to time and at periods of great prosperity, to reduce their capital.

It was done in the case of the Telegraph Construction Company, a favourite company with him at the time. When a large sum of money was made, the directors wisely said, "This is exceptional;" and they wrote down their plant, machinery, and *goodwill*—let them mark that; and returned that money to the extent of £8 a share to the proprietors. But it seemed to him, that in the case of this company exactly the reverse had taken place. They had got an increase in the value of that goodwill, and therefore in common sense they could not possibly write it down. He therefore trusted that they would not be led away by such proposals as that made by the proprietary to-day. He commended the board for dividing £245,000 amongst the shareholders, presuming before they arrived at the figure that they had taken good care to make ample provision for the future, to write down the goodwill of the business, or rather the patent rights and the machinery, and so on, which were always deteriorating; but certainly there could be no justification for writing down the goodwill of a business which seemed to be steadily on the increase.

Mr. Stewart inquired whether the directors were justified in allowing a portion of the proprietors to pay the sum of £10 without giving the same option to all the proprietors, a great number of whom were only called upon to pay £4. If the answer was that there was no distinct justification for the step, he had an amendment to the original resolution to propose.

The Chairman: May I ask whether the speaker is an original proprietor, or not? because if he is, he would know the facts of the case. When we started this company in the first instance, nobody believed in its success, and not many were much inclined to put money into it at all; and when we issued the prospectus and asked for our capital we had some difficulty in getting what we wanted, and we did then invite all proprietors to pay up in full. We not only gave them the opportunity, but made the request to do so, and urged upon them to do it. Therefore every proprietor had then the opportunity of paying up his shares in full. But I should like to tell you the whole story. Some proprietors, believing in the success of this company, did so, and they held now £10 paid up shares. Then, again, one gentleman in particular, I remember, came to the secretary having shares on which £4 had been paid, and thinking that they would go to a premium, was anxious to give a little more. We had got at the time money we called for, but that one gentleman sent to our former secretary who, under some misunderstanding, allowed him, after the shares were at a premium to go on paying up. That came before the directors. They were obliged to honour the engagement of their secretary, but finding what had been done, they put a stop to the operation, and nobody after that was allowed to pay up so as to make his £4 into £10 paid up shares. These are the exact facts of the case.

Mr. Brooksbank said that the gentleman who proposed the amendment was quite out of order, because the Board had not the power to reduce capital. It was *ultra vires;* they could not do it. He rose to ask whether it was their intention to pay this bonus in a larger proportion to those gentlemen who had fully paid up shares than to those who had only paid £4 on their shares. It might not have been convenient for many gentlemen to pay up the money at the time the appeal from the Board was issued, and he thought it would be a case of great hardship if their case was not taken into consideration. Surely they would never propose to give a bonus of £10 to those who had paid their £10 on the shares, and only £4 to those who had paid only £4. Were they going to perpetuate that? He would put it to the sense of fairness on the part of the Board. It was under exceptional circumstances those £10 shares became so much more valuable, under circumstances which none could foresee. He left it confidently in the hands of the Board, feeling sure that strict justice would be done to the large body of the shareholders.

Mr. Henry Maudsley would like, if the chairman would inform the shareholders, to know what amount was placed to the reserve fund of this company.

The Chairman: Before coming into this room I told you we went into certain figures. Our object was not only to see what amount we could offer for distribution, but also what was left to represent the capital and the assets of the company, and in doing so we found there was a very large margin indeed representing the paid-up capital, and we ascertained what we had in hand and what we should retain after distributing this £245,000. We did so not so much on your account as on ours, because we said to ourselves, "We are not going to incur any liability in this matter." In asking the shareholders to receive what we had to divide as profits, we retain not only a large reserve fund, but a large margin beyond it. That is the position in which we come before you. With regard to what Mr. Brooksbank said, it is hardly an accidental circumstance whether a man subscribes £4 or £10 (hear, hear). It may depend upon the accident of how much money he has at that moment to put into the company, but that is the only accidental part about it. I think it was with great deliberation that the gentlemen would subscribe either £10 or £4, as they thought proper, when they were first offered the option of subscribing either the one or the other. It is our desire to do even justice to everybody. I should be sorry to wrong any man. One or two gentlemen representing holders of the £4 paid shares have spoken very nicely their opinions, but we have heard nothing from the £10 paid shareholders; for this reason I think that there is no proposal before us which would do them any injustice; I am quite sure, however, that if we gave the holders of the £4 paid shares a part of this distribution in a larger proportion than they had subscribed, we should have a tremendous outcry from the £10 holders; the only thing we could do was to alter the articles of association. Article 4 says distinctly that the entire net profits of the corporation should belong to the holders of the shares of the corporation for the time being issued, or fully paid up, or deemed and taken as fully paid up, and in respect of such shares in proportion to the amount of all calls then paid on such shares. Of course these articles were not drawn up with a view of this latter state of things, the gentlemen who drew them up never contemplated what has since happened. But here are the articles by which we are bound. We have no choice in the matter. We cannot offer a certain sum to the £10 holders and another to the £4, but we must pay every holder in proportion, and that really seems common sense, on the face of it, especially when everybody had the option to begin with of subscribing either £10 or £4. Therefore, since the amendment has not been seconded, I shall ask you to pass the resolution unanimously.

Mr. Isaac would wish it to be distinctly understood that he had never suggested that the larger proportion of the division should be given to the £4 paid shareholders than to the £10. He would not like it to go forth that he had done anything so unjust.

The Chairman said he had done it in an indirect manner. He would now put the resolution. He might mention that he had a large amount of proxies, but he was quite sure it would not be necessary to use them.

Mr. Brooksbank: I have not had a satisfactory——

The Chairman: You are quite out of order, sir.

Mr. Brooksbank: Then if I cannot obtain information I shall feel it my duty to demand a poll.

The Chairman then put the resolution to the meeting and declared it carried with two dissentients.

Mr. Brooksbank: You have not proved the articles of association infallible, because you have moved an amendment to them. I contend that it is most grossly unjust—(hisses)—that those gentlemen who have paid £10 simply should have a larger share of the dividend than the other shareholders.

The Chairman: That closes the business of the meeting.

On the motion of Mr. Maudsley the usual vote of thanks to the chairman was carried unanimously, to which the chairman briefly responded, and the proceedings terminated.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.

ON Wednesday, at the company's offices, 61, Old Broad Street, the twenty-second ordinary general meeting of the above company was held, Mr. Thomas Hughes, Q.C., Chairman of the company, presiding.

After the notice convening the meeting had been read by the secretary, Mr. James Scott,

The Chairman said: Next comes the report and accounts, and I suppose you will, as usual, take them as read. So I will at once move that the report and accounts as submitted to you be read and adopted. The shareholders will have seen from the report that the half-year has been the most successful that the company has ever seen since its establishment. It will be, no doubt, satisfactory to them, as it has been to the board. The traffic receipts, which is the best test, as compared with the traffic receipts for the corresponding half-year of 1881, show an increase of £3,000, or very nearly so. Now, in respect to the distribution, the shareholders will see that again the board have thought it wise to carry a very considerable sum to the reserve fund. They are all aware—the shareholders who have attended these meetings—that this has been the policy of the board from the very commencement of the company, and that the board will not feel themselves in a thoroughly satisfactory condition, until the reserve fund reaches £50,000. They will be pleased to see that that amount is being very nearly reached, for the reserve fund now stands at £47,000. Then the shareholders will concur with the board in thinking that under the circumstances the dividend on the ordinary shares might be increased to 8 per cent. (hear, hear), and that is the recommendation which we shall lay before you for your assent. I do not think there is any other subject upon which I need trouble the shareholders further. They will have seen by the accounts that the expenses are practically the same, in fact, some £200 less than in the corresponding period of last year, although the business of the company has increased so largely. With respect to the question of the dispute with the Spanish Government the shareholders will see that everything has been done to bring that to a conclusion, and we trust that the result of the appeal will be to put us in a position of getting a return of that fund. This meeting will presently be converted into an extraordinary meeting, generally to deal with the question of auditors. Without trespassing upon your time any further, I will move that the report and accounts be received and adopted.

Mr. A. F. Low: I beg to second that.

Mr. Thos. Greenwood: I think we should recognise our improved position more fully than you, in your modesty, Mr. Chairman, have been good enough to put it. I think we should congratulate the board upon their successful management and ourselves upon our improved position, resulting from that management. We are now in a better position, so far as I am aware, than we ever were before. The proprietors may probably put figures together for themselves, but I can state that the earnings for the half-year have been 15 per cent. per annum. We pay 8 per cent. on the ordinary shares; have added £1,700 to our balance; £3,950 to our reserve fund, equal to 7 per cent.; and during the half-year we have earned and paid what is equal on the whole year to 7 per cent., and we have carried forward another 2 per cent. for the half-year, equal to one per cent. for the year, besides adding to our reserve fund £7,000, which stood at the beginning of the year £40,000, and at the end £47,000, which is equal to a 30th part of the whole capital of the company. This satisfactory condition is not to be exceeded by any telegraph company in existence. The only thing that has struck me as singular is that the company should still be burdened by that 10 per cent. per annum upon preference shares. I do not complain of the terms upon which those shares were issued. But now we have improved our position so much, and are in addition to all I have stated, practically purchasing a new cable out of revenue, I think the time has arrived when we should consider whether it is not possible

to place ourselves in a better position with regard to preference shares. I think it would be worth while to consider the issue of £100,000 of 6 per cent. preference capital in £10 shares, and that those shares should be convertible into ordinary shares, within a limited period at option of the holders, and failing that they should be redeemable by the company at par; that for every share held by the preference shareholders they should be entitled to one ordinary share in the company, and a bonus in cash. Another mode would be to authorise the board to invest some of our reserve in the purchase of preference shares when the market is suitable.

Mr. Newton asked whether there was any prospect of a communication with the Western Brazilian, so as to increase their connection with Cuba; and he would also like to know whether the board had any information as to the threatened competition by Mr. Jay-Gould. With reference to the issue of capital to take the place of the existing 10 per cent. preference, he did not think it possible to alter the conditions of that issue. Mr. Greenwood had thrown out the idea that they could use the capital to purchase. They could not do that. The Court of Chancery would not sanction that. For his own part, he always had a grievance against the company, for when they received notice in half-penny wrappers they were put on one side, whereas if under a penny stamp would be taken notice of.

The Chairman: Well, gentlemen, with regard to the question that has been asked, so far as we are aware the Brazilian communication is not likely to be carried out; I trust it may be in the future; and of course, as Mr. Newton has said, whenever it is carried out it will be a source of great profit to this company undoubtedly. With reference to the other competition which was threatened some time back, so far as we are advised it is for the present entirely gone off. This is also satisfactory for this company. Now comes the only other question raised—the 10 per cent. preference shares. The last speaker has stated that it is out of the question that power should be obtained. It was suggested by Mr. Greenwood, as an alternative, to buy up those preference shares. He has stated that so confidently that there may be some recent decision in the Court of Chancery, of which I am unaware, which makes it qtite out of the question that such an alteration should be allowed in a company of this kind. We have no power at present, so to purchase the preference share I for my part believe it to be by far the best way of dealing with them. I think that to-day we should, seeing the feeling that exists amongst the shareholders, for every speaker has referred to it and placed it in the position which the board has, consider that very carefully, whether we cannot so modify the articles of association as to obtain power to invest our surplus capital in the purchase of those preference shares. I am not quite sanguine as to the result, but if not we must consider one of the other two ways which have been proposed to us. I now, therefore, simply beg to move the adoption of the report.

Mr. Griffiths said that some time since he was consulted by a tramway company, and that matter was taken before the Master of the Rolls, and he decided that the preference shares are a prior mortgage on the company. It was the case of Dent *v.* The London Tramways Company. They must deal with every shareholder individually.

Mr. Newton said that the West Indian and Panama had similar shares to this company, but they succeeded in doing what Mr. Greenwood had suggested. They were obliged to meet those who did not acquiesce, and these persons got all that they asked for.

The motion for the adoption of the report and a resolution that a dividend be declared at the rate of 10 per cent. on the preference shares and at the rate of 8 per cent. on the ordinary shares for the half year were then put and carried unanimously.

The Chairman then announced that Alexander F. Low, Esq., was a retiring director, and he now proposed his re-election.

Mr. Griffiths seconded.

The Chairman: With reference to the auditor, I think I need not say anything on this subject. This, however, I am bound to say: we have had a new eye upon the accounts, and I think I may say, that the impression of the board is that they have a very able and deeply interested auditor to control in future the accounts of the company, in Mr. Thos. Greenwood, who now retires and offers himself for re-election.

Mr. W. A. Hooper proposed the re-election of Mr. Greenwood.

Mr. Cochrane seconded.

Mr. Griffiths said this was an adjourned discussion of what took place three months ago. He did not want to create any dissension in this family (laughter). Mr. Cowan had left this transitory state of mundane affairs, and he would pay his tribute of respect to him as well as to Mr. Brand. The view he took at the last meeting with reference to the question before them was that it would be better for them to have two auditors instead of one, because good book keeping was necessary and exceedingly valuable, and secondly, because it would tend to raise their company in the estimation of the public. While he admitted that they were very prosperous at the present time, their past history shows that that was not always the case. The National Ocean Telegraph Company had had disputes with them, the West Indian and Panama Company had also had disputes with them, and that kind of thing must tend to loss of reputation with the public. He thought there was some reason why the public did not invest more in their shares, and why the market value was not equal to their intrinsic worth. The public must have some difficulty, however, in discerning what was good and what was bad. He did not think that anything which would increase their reputation with the public would be otherwise than wise and prudent. It was for that reason that he advocated that they should have two auditors instead of one; a single error might escape the one keen eye and be detected by the other keen eye. If they considered one auditor was sufficient guarantee, all well; but as a question of caution he thought it would be wise to incur a little additional expense that they might be sure themselves and make the public sure also.

The Chairman: The question before the shareholders is proposed and seconded, that Mr. Thomas Greenwood be the auditor of this company.

Mr. Greenwood said, as a copy of the report of this meeting would get into the hands of the absent shareholders, he should like to express to them and to the meeting his full appreciation of the reply to his circular which he sent to them. A very large proportion of the shareholders had been good enough to lodge proxies in relation to his re-election. Upon the question of the two auditors, he had only to say, that being committed by the circular to a certain line of duty, he was bound to fulfil it. Out of the many proxies with which he had been favoured, only twelve of the number had expressed views on the question of the two auditors; and of these, eight were in favour of two auditors, and four in favour of one. The question, however, must be put to the vote.

Mr. Newton asked what proportion these four votes bore to the number of circulars sent out. He had a strong opinion in favour of having two auditors.

The Chairman: The meeting is now converted into an extraordinary meeting, for the purpose of determining whether you will have two auditors. The proposal that will now be put before you will be that the present rule as to the electing of an auditor, in the event of a casual vacancy, be altered in the way you will see in the notice which has been distributed amongst you. We wish these words in Article 116 of the present regulations of the company cancelled—"If any casual vacancy occurs in the office of any auditor appointed by the company, the directors shall forthwith call an extraordinary general meeting for the purpose of supplying the same;" and the following substituted in the place thereof, "If any casual vacancy occurs in the office of auditor, the directors may appoint any shareholder or shareholders, or any accountant or firm of accountants, to audit the company's accounts, with such remuneration as the directors shall think proper, and at the next general meeting held after such vacancy the shareholders shall proceed to elect an auditor or auditors." We had to call an extraordinary general meeting a short time ago for the purpose of electing an auditor upon the death of Mr. Cowan. It was very common to place that resolution in the old articles of companies, but I think it would be a mistake to put it in articles drawn up at the present time. It must be most desirable not to have extraordinary meetings called simply for the purpose of supplying a casual vacancy in the auditorship.

Mr. Greenwood thought that it would be better, if the chairman had no objection, to continue the existing meeting and determine the question of a second auditor, and after determining that, and seeing whether the "Ayes" had it, then to proceed to the election of a second auditor.

Mr. Page: I second that.

The Solicitor: It has not been proposed yet.

Mr. Newton: Just to test the question I will move it.

Mr. Hooper remarked that one auditor had been sufficient for this company for the past twelve years, and he thought the proposal for a second seemed to indicate a want of confidence in the board of management, and in their new manager (no, no); that was the view he took of it. He therefore begged to move as an amendment, that one auditor was quite sufficient for such a small and simple statement of accounts as they had so clearly put before them from year to year. He did not think that the shareholders should use such language about confidence in the board as was generally done, and then on the first occasion that they had an opportunity of practically showing that confidence——

Mr. Newton: Mr. Chairman, I protest against that.

The Chairman: The shareholder has a right to express his views.

Mr. Cochrane would second the suggestion made, but on a totally different ground. He thought that it was better to put the responsibility on one man rather than to distribute it over others.

Mr. Newton had firmly expressed his opinion of confidence in the board, and had stated many times that the accounts were the clearest and most faithful of any telegraph company now before the public. He had not the slightest intention of raising any question of confidence in the board. He thought that was out of the question with a company paying 8 per cent. to its ordinary shareholders. The vote must be "Yes" or "No," for they could not put the amendment.

The Chairman: I do not consider the amendment irregular. Any shareholder has a right to put it in that form. The original proposition is that a second auditor be appointed.

Mr. Griffiths: In Parliamentary procedure a direct negative cannot be put as an amendment.

Mr. Greenwood: We shall not consider it an act of want of confidence in us if the shareholders have determined to have two auditors.

The amendment was then put, and the result was nine for and eight against.

Mr. Griffith repeated his previous remark that a direct negative was not an amendment.

Mr. Greenwood thought he should have some difficuly, because he could not record the proxies he held unless there were a poll.

The Chairman: The amendment is practically put as an original motion.

Mr. Hooper having withdrawn his amendment, hands were shown on the original motion—ten in favour and nine against.

Mr. Greenwood: I think I must demand a poll, but under compulsion.

A poll was then taken, when the numbers were for a second auditor, 28; against, 55.

The Chairman: That is taking the vote of the meeting without the board. The board, however, are of opinion that one auditor is sufficient.

Mr. Lindsay Scott (to the Chairman): Did you ever know of a board nominating an auditor?

The Chairman: Oh, yes; but in this case the suggestion came from the shareholders.

Mr. Newton could not see that much would be saved by the alteration.

Mr. Greenwood said he was present at the meeting when the suggestion for the proposed alteration of articles was made. Many of the shareholders were brought a long way to the meeting only six weeks before the half-yearly meeting six weeks later on. The shareholders then asked for the alteration: it was not for another body of shareholders to say whether they liked it or not. If a vacancy occurred, and they had only one auditor, and must have accounts presented, they must fill up the vacancy and put up with the inconvenience, or wait till the following meeting.

Mr. Lindsay Scott thought they did not need to alter an article to meet an emergency which might not occur once in fifty years. Mr. Greenwood looked like living many years yet (laughter).

Mr. Newton asked whether he would be irregular if he proposed an amendment that it was not necessary to alter the articles of association?

The Chairman said it was entirely their own question: the suggestion had come from the shareholders.

Mr. Griffiths thought that the expense of a second meeting to confirm the alterations, if agreed to, would be quite as great as calling a meeting to appoint a new auditor. The recent unfortunate necessity has only arisen once since the establishment of the company, twelve years ago. It seemed to him that it would be wise to leave things as they were.

Mr. Newton remarked that he thought the proposed alteration must fall to the ground.

There being no other remarks a unanimous vote of thanks to the Chairman was passed on the motion of Mr. Newton, and the proceedings terminated.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.

A HALF-YEARLY general meeting of this company was held on Tuesday last, 18th inst., at their offices, 38, Old Broad Street, Sir Daniel Gooch, Bart., M.P., Chairman of the company, presiding.

Mr. Shuter, the manager, having read the notice convening the meeting,

The Chairman said: Gentlemen, this is a meeting for the purpose of your asking questions rather than for any report from the board. We present no report or accounts, but I will state shortly the work which we have done during the past half year. We have manufactured about 1,000 miles of cable and laid about 550 miles of cable manufactured within the last year. We have also laid the German Union Cable between Emden and Valentia. That was completed in April by the *Scotia*. We have repaired the North Sea Cable, which is also now completed, and the *Kangaroo* has been twice to the Brazils to carry out the cable for the Western and Brazilian Company, and to repair the Brazilian submarine portions of the cable near Pernambuco. The *Scotia* has now been out about two months in the Atlantic repairing the Brest and St. Pierre Cable for the Anglo-American Company, and she recovered the cable in 1,940 fathoms of water in the Atlantic, and repaired that and put in 60 miles of new cable. She then went to repair the fault that has been for some time existing in the cable near Brest. That she is now engaged in doing. She has recovered the ends and buoyed them; but the weather has been so bad that she has not been able to put in the new piece. However, we hope that that will be completed as soon as we get two or three days of fine, calm weather. She will then go to the mid-Atlantic again to do some more repairs which are necessary there. It is a great thing to do to lift a cable which has been down twelve years in the mid-Atlantic, to repair it, and to put in a new piece, and to restore the cable. The cable taken out was in very fair condition—in fact, very good condition considering the length of time it had been down. But there were traces of defects which had taken place at short intervals of the cable from some chemical, no doubt, at the bottom of the sea. It does not continue far, but it is quite sufficient to create a weak point in the cable. We thought it almost more than we could expect to recover that cable and to repair it at such a depth of water after it had been down for such a long period. We are endeavouring to keep our works going by doing all we can to secure cable work. Having told you practically what we are doing I am afraid I have nothing to tell you as to the future. We are, of course, negotiating for work, and I hope that we shall be able to continue as we have hitherto done. I should be glad to answer any questions that any gentleman is inclined to put.

Mr. Ealing said: Is the 700 miles you have now of government contract work to be done in a hurry?

The Chairman: I do not know what you refer to.

Mr. Ealing: I only heard that, and I ask you the question.

The Chairman: We have not got a government contract.

Mr. Ealing: You had one.

The Chairman: We did have a contract. We have laid a cable of 900 miles in the middle of the half-year. Has any other shareholder any question to ask? There is no resolution to put. If there is no other question to ask I must declare the meeting at an end.

A vote of thanks to the Chairman for his conduct in the chair was then moved and seconded by two of the shareholders present, and carried unanimously. The Chairman shortly thanked the meeting for their confidence, and the proceedings terminated.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY, LIMITED.—We are informed that the business of the Company for the past half-year has been satisfactory, and that the directors will, at the ensuing meeting, recommend the distribution of an interim dividend of 5 per cent., or 10s. per share, free of income-vable on the 26th instant.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—At a meeting of the board, it has been resolved to recommend a final dividend of five shillings per share (free of income-tax), such dividend to be payable on and after the 16th August next, making, with the interim dividends already paid, five per cent. for the year ending 30th June last, carrying forward £232 16s. 8d., after having carried to the reserve fund £9,531 9s. 1d., making it up to £264,000.

OFFICIAL QUOTATION has been granted to the Pilsen, Joel, and General Electric Light Company, Limited."

APPLICATION FOR SETTLING DAY AND QUOTATION has been made to the Stock Exchange Committee on behalf of the "British Insulite Company, Limited."

THE UNITED TELEPHONE COMPANY.—The directors have decided to recommend, at the meeting to be held on the 1st. prox., a dividend of 5 per cent. on the share capital, subject to audit.

THE BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND (LIMITED).—The directors have appointed Mr. F. M. Brockelbank as secretary to the company.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations July 19.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	19½-20½	21.20.19¾.20¼.20.19½.19.18¾.½.¼.19½.19.¼.½.20.18¾.½
		Do. Do.	10	41 - 46	45.3.2.4.2½
30,000	5	Brush Electric Light & Power Co. (Scotland)	5	1½- 1¾	
150,000	1	Electric Light and Power Generator Co.	1	½- ¾	¾.1½
25,000	5	Great Western Electric Light & Power Co.	2½	1½- 1¾	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	10½-11½	11.10¾.½.¾.½.⅝.½.11.10¾
40,000	5	Indian & Oriental Electrical Storage Works	2	2½-	
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1 - 1½	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49 - 50	49 xd.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div until 6 p. c. has been paid to Pref.	100	79 -80	79½ xd.
2,441,800*l.*	Stk.	Do. Deferred }	100	19½- 20½	20
130,000	10	Brazilian Submarine, Limited	10	11¼- 11¾	11¼.⅜.72
16,000	10	Cuba, Limited	10	9½- 10½	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 6¾	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 11¾	11¼.⅜
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10½- 10¾	10½.9/16.⅝.9/16
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11-11¼	11¼.⅜.3/16.¼ xd.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6⅝.½.⅝
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	12¾
125,000	10	Great Northern	10	12½- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26 - 27	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	2 - 2½	
5,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	265 -275	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	98 -103	
37,350	12	Telegraph Construction and Maintenance	12	28 - 29	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	1½
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7 - 7½	7
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	107 -112	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	99 -102	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1½- 2¼	
34,563	10	Do. 6 per cent. 1st Preference	10	8 - 8½	8¼
4,669	10	Do. 6 do. 2nd do.	10	6½- 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1¾	17/16.½ xd.
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	½- ¾	¾.½
100,000	5	United Telephone Co.	5	11½-11¾	10¾.11½.½.¾.11.¾.⅝.12.⅝.11½.12

TRAFFIC RECEIPTS.

West Coast of America Telegraph Company. The gross earnings, traffics and steamer, for the month ending June 30th, 1882, were £3,425, against £3,40[illegible] in the corresponding period of last year.

Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending July 7th were £1,719, after deducting the "fifteenth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 244.

THE ELECTRIC LIGHTING BILL.

THIS has formed the subject of a long and carefully worded letter from the pen of Sir Frederick Bramwell, published in the columns of the *Times* on Friday, the 21st inst. It was followed the next day by another epistle on the same matter, and bearing the signature of Robert Hammond, the well-known originator of the Hammond Electric Light Company. Both these communications are well worthy the serious consideration of all interested in the future prospects of the electric light, and we need scarcely say that the arguments of both gentlemen are entitled to careful thought.

In speaking of the compulsory sale of electric light undertakings at the end of fifteen years Sir Frederick says :—

> The Electric Bill, by clause N of section 14, provides that where the lighting is done by an individual or by a private company, under a provisional order confirmed by an Act of Parliament, then at the end of fifteen years the local authority of the district lighted shall be entitled to say that it desires to purchase the undertaking, and thereupon the undertakers shall be compelled to sell. This in itself would be a sufficiently hard provision were the terms of payment fair; but the terms of payment are most unfair, for the arbitrator who, failing agreement, is to fix them is forbidden to take into account in so doing either past profits, goodwill (which means present profits), future profits, or any allowance for compulsory sale, and, having been thus told what he is not to allow, he is directed to ascertain the then value of the land, buildings, machinery, and plant, having regard to their suitability for the purposes for which they are intended; and this is to be the sole payment for the acquisition of the undertaking. Further, if the local authority should not choose to exercise this option at the end of fifteen years, then at each recurring period of five years the same option is to re-arise.
>
> As I have said, there is nothing in the nature of electric lighting to justify exceptional harshness; on the contrary, it is regarded with approval, and thus, if there be any exceptions, it is to be supposed they would be exceptions in favour of this useful, desirable, but undeveloped industry. I fear the obvious conclusion to be drawn from the foregoing considerations is that in all future applications to Parliament for a Bill to light a town with gas, or to supply it with water, or to make a new railway from A to B, there will, in the interests of consistency, be inserted provisions that at the end of the fifteen years the local authority may buy the gas undertaking at the then value of the fifteen years' old pipes and fifteen years' old works, that it is to get the waterworks on similar terms, while the railway, extending over the districts of many local authorities, will be doomed to be acquired by the Government for the then value of the land, works, rails, and rolling-stock.

Sir Frederick makes out a very dismal prospect for the future development of any enterprise, but we scarcely think he is justified in comparing established undertakings such as waterworks or railways, the details of which are all known beforehand, with a practically undeveloped (as the writer admits) industry like the electric light. It is evident that Mr. Chamberlain had the public weal very much at heart when framing the clauses of his Bill.

Electric lighting has made vast progress of late years, but in an intermittent and partially unsatisfactory manner as far as the general public is concerned, for it is still a most difficult matter to get at the truth of the question of cost, as any report on the subject generally leaves something unmentioned, and the opponents of the electric light have generally managed to get hold of some weak point in the arguments of its adherents. It is the general vagueness existing on this point of relative economy between the electric and other methods of illumination, and also the unscrupulous way in which much of the electric light business has been carried out, which probably induced Mr. Chamberlain to frame his Bill, so that electric lighting companies shall not receive more than fair returns for work done. We do not think that Sir Frederick Bramwell need fear that private enterprise in this country will be discouraged, and such undertakings pass into the hands of governing bodies. As a matter of fact, we need only mention the telephone, with which Sir Frederick has had so much to do. Instead of being monopolised the telephone industry has just been thrown open to all comers with certain restrictions, which we cannot imagine will be of a very severe nature. We believe with Sir Frederick that the making of governing bodies (generally) is a mistake, but surely we may rely on the good sense of Parliament to know where the line must be drawn. In the latter portion of his letter, the writer states :—

> At the end of 15, 20, 25, and every period of five years after the 15, the local authority watches to see if there is a profit, and if there be, then it comes in and buys, not upon the profit, but upon the materials. If there is no profit, so that it would not be worth while to buy the materials in order to earn the income, then there is no obligation on the local authority to buy at all, and thus in effect the Bill says, "As long as there is no profit or a poor profit, you, the undertakers, may continue to work, but the instant you get anything like an adequate return, then we will come and buy you up at a price which must inevitably be a comparatively small fraction of the capital you have laid out in the undertaking." I feel compelled to repeat that which I told the committee, "This is a monstrous proposal."
>
> It is on the foregoing grounds, I say, that the passing of this Bill must be looked upon as the beginning of the end of the carrying out of public enterprises by means of private capital.

This matter of profit or no profit depends almost entirely upon the management of the directorate of a company, and we do not see the force of Sir Frederick's argument that "as long as there is no profit, or a poor profit, you, the undertakers, may continue to work." We can quite understand the local authority as being anxious to buy a profitless concern at the end of a definite period, for the simple reason that under new management the undertaking might be made to yield a very fair return. Sir Frederick must know as well as any person in existence that the question of profit or no profit is usually a question of management. We have only to call his attention to a leading electric light company as an example of this. Others, probably, have electrical apparatus of as good, if not superior, nature, but that is not of much avail if the smartness of the directorate is absent. Mr. Hammond, who corroborates all the views expressed by Sir Frederick Bramwell, in one portion of his letter says :—

> In erecting electrical apparatus in a town, a very large proportion of the outlay will be for labour in laying the mains, erecting the posts, fixing the wires, putting in the foundations, and making the connections with houses on the route. Now, if at the end of fifteen years, when the plant is turned over to the local authority, no value is to be placed upon this very important portion of the first outlay, then consumers, during the term allotted to the electric light company, must annually bear their proportion of these dead expenses; and it is therefore evident that unless the electric light company has a long term, I should say at least twenty-one years, the proportion of the dead expenses annually will be so heavy that the consumers would find the price charged for the electric light too onerous. If however the suggestion of Sir Frederick Bramwell were adopted, and the plant at the end of the term allowed to the electric light company were taken over upon its value as a going concern, then all the dead

expenses forming such a large proportion of the original outlay would be paid for by the local authority taking over the business, and would be quite fairly charged to them, since they would be forced to spend a like amount if they started *de novo* in their town.

Looking at the matter purely from a commercial point of view, being the one which my managing directorship of an electric light company daily presses upon me, I should say that the Bill with its present purchase clause is not sufficiently tempting to induce capitalists to put money largely into companies contemplated by the Act.

They will feel that the early consumers, though willing if necessary to pay more than the price of gas for the manifest advantages connected with the electric light, could not be fairly asked to bear the dead expenses which should always be considered as part of the capital, and not charged to revenue.

If, on the other hand, the clause is amended so that the local authority which elects to purchase pays for the electrical apparatus upon its value as a going concern, then an immense stride will have been made towards admitting the public to participate in the boon, as the result would be an immediate setting on foot of undertakings to supply the electric current from house to house.

In the meantime we cordially agree with both gentlemen that there is ample work and to spare of an isolated nature for all the electric light companies at present established; but that Sir Frederick Bramwell's forebodings that the passing of this Bill means the beginning of the end in carrying out public enterprises with private capital are ill founded we feel convinced. He is right in believing that private enterprise has made England what she is, and we should be sorry to think that this will not be still more developed in the immediate future.

THE CHEMISTRY OF THE PLANTÉ AND FAURE CELL.

[On pages 21 and 211 of vol. X. of the ELECTRICAL REVIEW we reprinted, from the columns of our esteemed contemporary *Nature*, two interesting and valuable articles bearing on the above subject. These were written by Drs. Gladstone and Tribe, and we now republish a third paper by these two gentlemen, for which we are again indebted to the same journal.]

PART III.—*The Discharge of the Cell.*

THE two plates of a Planté or Faure battery consist essentially of lead peroxide as the negative element, and metallic lead in a spongy condition as the positive. These are brought into communication with one another through the lead plates which support them, together with the connecting wire.

The lead peroxide reacts both with the lead plate that supports it, and with the lead on the opposite plate. At first sight, it might be expected that the reaction between it and the supporting plate would be the greater, as the space between them is so small, and the resistance of the intervening liquid in consequence almost inappreciable. The action is, indeed, probably greater at the first moment, but, as explained in our first paper, sulphate of lead is immediately produced, and that which lies at or near the points of junction forms no doubt a serious obstacle to further local action and admits of the lead on the opposite plate coming more fully into play.

If we consider *à priori* what is likely to be the reaction between lead peroxide and lead, with water as the connecting fluid, we should expect :—

$$PbO_2 \mid H_2O \mid H_2O \mid Pb = PbO \mid H_2O \mid PbH_2O_2.$$

On experiment this is found to be actually the case, yellow oxide appearing on the negative plate, and white hydrate on the positive.

If, however, the reaction takes place in presence of dilute sulphuric acid, the result will inevitably be sulphate on both sides, for even if oxide be first formed, it will be attacked by that acid. Of course this production of lead sulphate on [illegible]ide might be expected gradually to produce a perfect [illegible]cal equilibrium. This, in fact, does take place under certain circumstances, but not under others. The reaction on the negative plate is always of this character, as far as our analyses have shown. We have invariably found the deposit to consist of sulphate of lead mixed with unaltered peroxide. If, however, the cell be allowed to discharge itself rapidly the lead on the positive plate is converted, not only into the sulphate, but, very partially, into lead peroxide. This is sometimes evident to the eye from the puce colour of the superficial layer, and we found also that this was confirmed by several chemical tests.

It is difficult to conceive how the reduction of the peroxide of lead on the one plate to oxide or sulphate should be attended by a direct oxidation of lead on the other plate up to peroxide itself, as that would involve a reversal of the electromotive force. It is more easy to imagine that the peroxide results from the oxidation of sulphate of lead already formed, through the agency of electrolytic oxygen.

When this peroxide is formed on the positive plate, it is not difficult to foresee what must happen. A state of electrical equilibrium will be approached before the peroxide of lead on the negative plate is exhausted. But the two sides are in very different positions with regard to local action. On the negative plate, the peroxide being mixed with a great deal of lead sulphate, it will suffer decomposition only very slowly through the agency of the supporting plate, but the lead peroxide on the positive plate, being mixed not only with lead sulphate, but with spongy metallic lead, will be itself speedily reduced to sulphate. Hence, on breaking the circuit, when local action alone can take place, the peroxide formed on the positive plate during the discharges will be destroyed much more easily than the original peroxide on the other plate. The difference of potential between the plates will be restored, and on connection the cell will be again found in an active condition.

Now it has been frequently observed that partially discharged accumulators do give an increased current after repose, that is, after the circuit has been broken and re-established. It remained for us to ascertain whether the chemical change above described coincided in any way with the physical phenomena. For this purpose we prepared plates according to the method of Faure, and examined carefully the changes of electromotive force and strength of current, which took place during their discharge under known resistances, and the chemical changes that took place under the same circumstances.

We found that the initial electromotive force of freshly prepared cells was 2·25, 2·25, 2·21, and 2·31 volts, averaging 2·25, but that after standing for thirty minutes or so, or when allowed to discharge for a few minutes, it was reduced to about 2·0 volts. We take this to represent the normal electromotive force of the arrangement of lead, lead peroxide, and dilute sulphuric acid, and believe that the higher figure obtained at the first moment is due to the hydrogen and oxygen occluded on the respective plates, and which either diffuse out or are speedily destroyed.

We found, however, that in the discharge the electromotive force diminished under certain conditions. Thus, in an experiment in which the external resistance was 1 ohm, and the internal 0·58 ohm, the E.M.F. sank in forty-five minutes from 2·25 to 1·92, but after being disconnected for thirty minutes, it was found to have risen to 1·96, and after eighteen hours' repose it had actually risen to 1·98 volts. These observations were made many times in succession during the course of the experiment which lasted six days.

With twenty times the external resistance, the diminution of electromotive force was much slower; but after discharging three days, the fall was more pronounced, and the rise on repose very apparent.

With 100 ohms resistance the electromotive force varied very little for three days.

It is more difficult to obtain satisfactory chemical evidence of a quantitative character. It is clear that as chemical examination means the destruction of the substances, the same plate cannot be analysed in two consecutive stages. Nor can two plates be easily compared with one another, although they have been formed under the same circumstances. Even the same positive plate, during or after discharge, presents to the eye very different appearance in different parts. To a certain extent we obviated this difficulty by cutting the plate in two, longitudinally,

analysing the one half at once, and allowing the other to repose for a given time before examining it for peroxide of lead.

As to the estimation of peroxide in the presence of metallic lead, we finally adopted as the best method that of reducing it by means of oxalic acid, although we were not certain that the whole amount is obtained in this way, even though the solution be kept hot for a considerable time.

By this method many chemical examinations were made of the positive plate. The results are as follows:—First of all, when the external resistance did not exceed 20 ohms the peroxide of lead was generally visible in patches, and its presence was demonstrated and approximately measured by various chemical tests. On repose, the quantity of this peroxide visibly diminished, and in the majority of instances the chemical analyses also showed a smaller amount. In all cases sulphate of lead makes its appearance early in the action, and gradually increases in quantity, becoming finally the only product of the discharge.

The deposit on the negative plate shows the presence of nothing but sulphate of lead in addition to the unchanged peroxide. At the conclusion of the action we have always found more or less of this substance unaltered. Thus, as one instance, after a discharge lasting five days, and approximately complete, we found that only .68 per cent. of the deposit was lead sulphate

We conclude therefore that the chemical action of the discharge is essentially what is expressed by the following theoretical formula:—

$$PbO_2 \mid H_2SO_4 \mid H_2SO_4 \mid Pb = PbO \mid H_2O \mid H_2SO_4 \mid PbSO_4,$$

which becomes

$$PbSO_4 \mid H_2O \mid H_2O \mid PbSO_4.$$

This reaction is, however, sometimes complicated by the formation of a small amount of peroxide of lead on the positive plate. We believe this to be due to the oxidation of sulphate, an action which was explained in our last paper.

Another conclusion has reference to the resuscitation of power observed on repose. This is not due to any purely physical action, but is a necessary consequence of the formation of PbO_2 on the positive plate. As sooner or later the result of the action becomes solely $PbSO_4$, this temporary formation of peroxide does not seriously affect the quantity of electrical force that may be regained from the accumulator, but it does affect the evenness of its flow. The flow is more regular if the discharge be made slowly, but in that case the loss on the negative plate from local action will probably be greater.

As to practical conclusions, we may note—1. Although, as stated in our paper of March 9th, the most economical arrangement for the initial charging of the cell is to "make the red lead to be hydrogenated much smaller in amount than that to be oxidated," yet, as foreshadowed in the same paper, this arrangement is not desirable for the discharge of the cell. Nor is it for its subsequent charging, since, as will have been seen, the substances to be acted upon are now very different. On the negative plate there will be the sulphate of lead produced by the discharge, plus sulphate of lead, produced by local action, together with more or less unaltered peroxide. On the positive plate there will be the sulphate of lead produced by the discharge, together with excess of lead, if any. Unless, therefore, the peroxide of lead unacted upon is allowed to be very considerable, the quantity of lead compound on the two sides ought to approach equality. 2. Care should be taken that sulphuric acid is in sufficient excess to allow of there still remaining some of it in solution after all the available lead has been converted into sulphate. If it is removed and only water is present, an oxide or hydrate will be produced with probably some serious consequences to the cell.

PATENTS FOR SIX MONTHS.—The number of applications for patents during the first six months of the present year amounted to 3,102, exhibiting a marked increase over those of the corresponding period of 1881, when only 2,865 applications were recorded. London furnished 775, the United States 397, France 261, and Germany 250. The electric light occupies a very prominent position amongst the inventions.

HARRISON, COX-WALKER & Co.'s TELEPHONE CALL.

THE object of this apparatus (devised and patented by Mr. Anders, formerly electrician to the American Bell Telephone Company) is to enable any one subscriber out of a number looped in on a single circuit, either to be called by the central exchange office, or by any other subscriber.

The whole apparatus is of a very simple nature, and consists of two keys and an indicator at each office or station; this indicator is shown in outward appearance by fig. 1.

One of the two keys sends positive currents, whilst the other sends negative currents; these two keys are of ordinary construction and do not possess any peculiarities.

The indicator at each station is in outward appearance similar to fig. 1, the hand is worked by a step-by-step propelment, worked by an electro-magnet with a polarised armature pulled in one direction by a spring, so that only the intermittent currents sent by one of the two keys will actuate it and work the hand round the dial. As all the indicators are similarly worked, and as they are all looped in on one circuit, it follows that they will all move in unison when intermittent currents are sent by the key referred to.

The general working of the apparatus is as follows:—the index hands of all the instruments being at zero, any station who desires to call, depresses key No. 1 several times (the reason of this will be afterwards explained), he then does the same with key No. 2, so as to send intermittent positive currents, say, out to line, and this he continues to do until he has worked the hand of his indicator round to the number of the subscriber whose attention he desires to call. This being done he next again depresses and raises key No. 1 several times, this has the effect of sounding a bell in the instrument of the subscriber referred to. After the communication is finished, he again sends intermittent currents from key No. 2, so as to work the index hand of his apparatus round to zero; when, however, this has taken place, he still continues to alternately depress and raise his key a few more times, though this operation will not cause those index hands which have arrived at zero to advance further, since they become arrested at the latter point by a stop; those hands, however, that may have accidentally lagged behind will, by the few additional currents, have been brought to zero.

Now the first operation which took place—namely, the depression of key No. 1—had for its object the release of all the index hands from the zero stops against which they had become arrested, so that when key No. 2 was depressed they would be free to move forward. The way in which this releasing is effected, and the means by which it happens that only the bell at the office of the subscriber it is desired to call is rung, will be understood from figs. 2 and 3, the latter being an enlarged general plan of portions of the mechanism.

Referring to fig. 2, *w* is a propelment wheel actuated by an anchor attached to a soft iron tongue. This tongue is polarised from its lower end by one end of a permanent steel magnet, M, and plays between the two poles of two electro-magnets, whose other poles are connected by a soft iron strap. The anchor is normally pulled over to the right by a spiral spring (not seen in the figure).

A second soft iron tongue, *t* (*see* fig. 3), is polarised by the second pole of the permanent magnet, M, and this tongue also plays between the poles of two electro-magnets. The four electro-magnets are connected together in one circuit, the connections being so made that when the magnets are excited, one tongue tends to move to the right, whilst the other tends to move to the left. It is evident, therefore, that as one tongue is normally drawn to the left by a spring, and tongue, *t*, is normally pressed to the right by another spring, that currents in one direction only affect the former, whilst currents in the opposite direction only affect *t*.

Referring now to fig 3, *w* shows the propelment wheel, a portion of which is broken away to show the disc, *f*. This disc is fixed to the same axle as *w*, and turns with it. To the tongue, *t*, which is axled at *h*, is fixed the curved wire, *k*, to

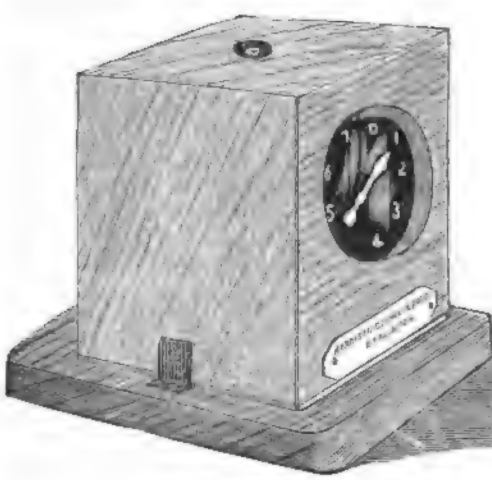
the extreme end of which is attached the bell hammer (*see* fig. 2). Attached to *k* is a small projecting piece, *d*. This projecting piece being in a line with the disc, *f*, presses against the circumference of the latter when *k* is moved to the right by the attraction of the tongue, *t*, thus the hammer at the end of *k* is prevented from striking the bell. When, however, the disc has, by the movement of the wheel, *w*, become turned round so that the notch, *g*, comes opposite (or nearly opposite) *d*, then *k* can have its full movement and its hammer can strike the bell.

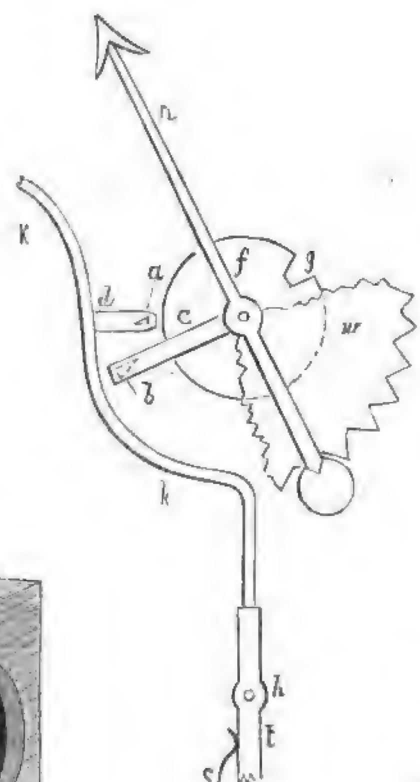
On the axle on which *w* and *f* are fixed is secured an arm, *c*. This arm has near its end and on its inner face a small wedge-shaped projection, *b*. The piece, *d*, has a similar projection, *a*, on its outer face. Now supposing *k*

These latter currents, as explained at the beginning of the article, are sent at the commencement of the calling operations.

Now by so setting the position of the notch, *g* (on the disc, *f*), in the various instruments that the notch in, say No. 7 instrument, comes opposite the piece, *d*, when the indicating hand of No. 7 points to that number, then it is evident that the bell of No. 7 only can be sounded when the index hands of all the instruments point to 7; and similarly if all the hands point to 5, then the bell of No. 5 only can be sounded.

As the wheel, *w*, has forty teeth cut on it—that is to say, as five movements of the anchor will be required to move the index hands from one number to the next, and as the





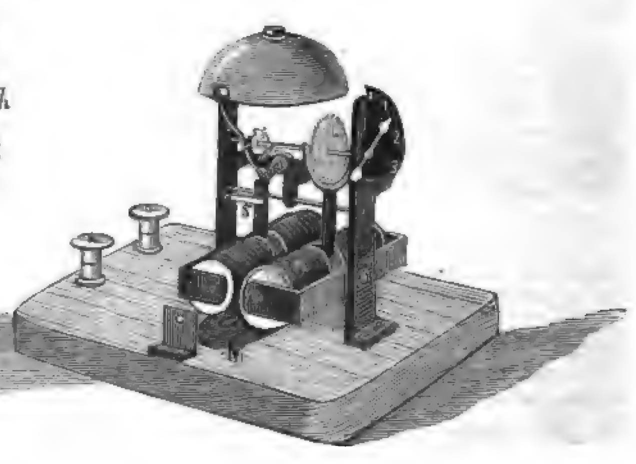


FIG. 1. FIG. 3. FIG. 2.

to be in its normal position, then, if the arm, *c*, becomes moved round, the projection, *b*, will come in contact with the projection, *a*, and the movement of *c*, and consequently also of the hand, *n*, will become arrested; in this position *n* points to zero on the dial.

Now the position of the arm, *c*, is so arranged with reference to the wheel, *w*, that when *b* has been worked round so as to be just in contact with *d*, then the propelment anchor is just on the point of moving *w* under the influence of the retractile spring. Under these conditions it follows that if *k* be moved slightly to the right by the action of the electromagnet acting on *t*, so as to free *a* from *b*, then the wheel, *w*, will move slightly forward by the propelment anchor being pulled quite home into the teeth of *w* by the spring. When, therefore, *k* drops back to its normal position, the projection, *a*, will come underneath the projection, *b*, and the movement of *c* will no longer be prevented. Thus the wheel, *w*, and the pointer, *n*, are free to move. We thus see that when a series of intermittent currents in one direction are sent by key No. 2, the wheel, *w*, and the indicator hand, *n*, can be worked round to zero, but no further, and that in order that the rotation may be continued it is necessary to move *k*, which is done by a current, or currents, sent by key No. 2.

notch, *g*, is made sufficiently broad—an accidental skip of one or two movements of the anchor in the course of the revolution of the wheel, *w*, will not prevent the bell ringing at the proper station. Such accidental skipping as has been pointed out will be corrected at the final stage of the calling operation by bringing all the hands up to the zero stops.

HASKINS' ARC ELECTRIC LAMP.

THIS is the invention to which we alluded in a short note last week under the name of the "Diamond" arc lamp. We now purpose entering more fully into its construction and design, for although any person can devise an arc lamp differing in some points from preceding specifications, and notwithstanding that the number of such lamps is legion, there are decidedly merits in the invention under discussion which deserve more than a passing notice. Mr. Haskins is well known in America, and here also, as a leading electrician, and on this account alone one would naturally expect something out of the ordinary from his inventive faculties. The lamp in question, as we have before stated, is to be seen in

action at 874, Euston Road; the current necessary for producing the light being supplied by a Weston dynamo-electric machine. Before entering into a description of the Diamond arc lamp we will briefly call the attention of our readers to a somewhat similar idea of Mr. Haskins, which we extract with an illustration (*see* fig. 1) from the *Official Gazette* of the United States Patent Office. The number of this patent is 261,091, and was filed in the

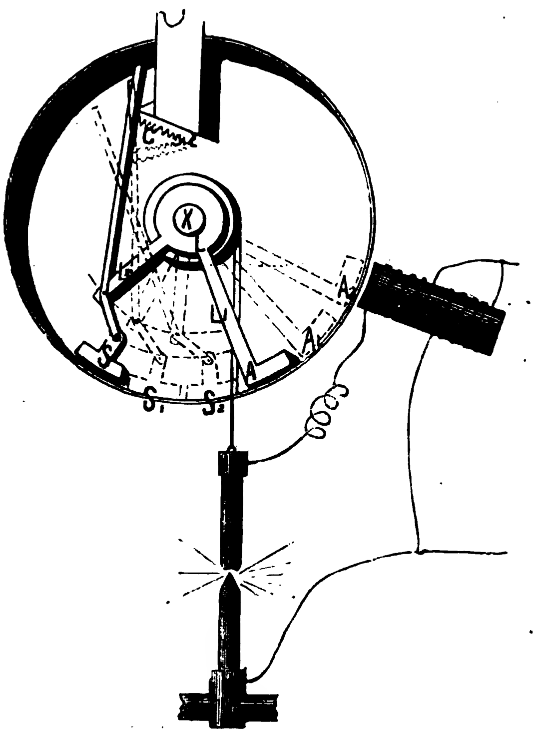


FIG. 1.

United States of America Patent Office January 25th, 1882. The claim of Mr. Haskins which follows will sufficiently explain the sketch :—

"The combination, substantially as hereinbefore set forth, of the movable electrode of an arc lamp, an electro-magnet vitalised by the light-producing current, and an intermediate

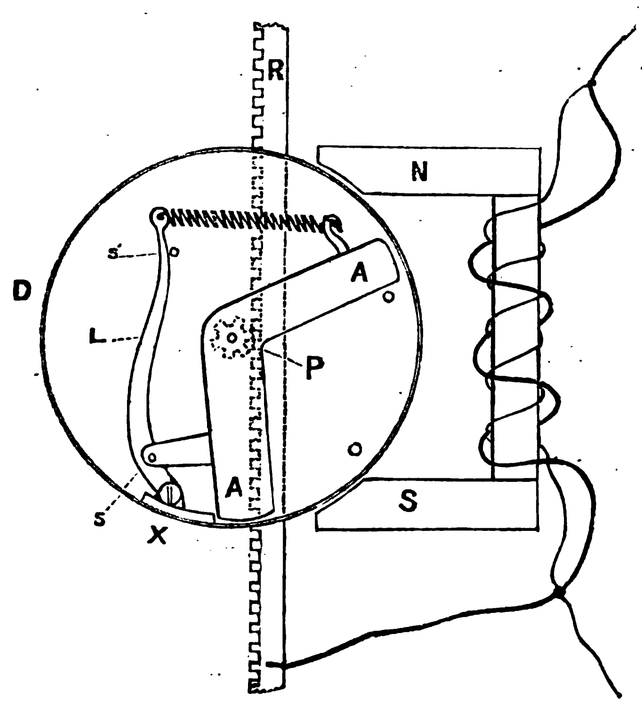


FIG. 2.

regulating mechanism consisting of a drum mechanically connected with said electrode, and an armature and a clamping-lever connected together and pendulously suspended from the axis of said drum, said clamping-lever being adapted to act against the inner periphery of said drum."

It is evidently intended that the fine wire of the electro-magnet shall, when the current passes through, partially demagnetise the core; or rather weaken the magnetism produced in the core by the main current flowing through the thick coil.

Most of the arc lamps at present in operation have the lower carbon fixed, and the upper one is allowed to approach the lower when necessary by its weight alone. The object of the electro-magnetic devices of various forms employed in such lamps is usually for the purpose of parting the carbons, thus forming the arc, regulating the length of the arc, and also for releasing the grip or clutch holding up the top carbon, so that it may descend towards the lower when the length of arc increases beyond its normal state. In the same manner the Haskins lamp depends upon gravity for the descent of the upper carbon, and an electro-magnetic apparatus, or feeding mechanism, applied to the upper carbon regulates its action. In the following sketch of the working parts of this invention, fig. 2, it will be seen that the upper carbon holder is shown—as in many other lamps—as a light toothed bar or rack, R. This gears into a pinion, P, fastened to the centre of a flanged disc, D, which is accordingly rotated by the lifting up or falling of the rack. To control the downward movement of the carbon holder it is only necessary to apply a brake to the inside rim or flange of this disc, and as this latter may be of any required size, the power requisite to check its motion and resist the weight of the carbon holder may be very small, and the magnetic attraction necessary for this purpose may, therefore, be comparatively slight. The brake is shown in the figure at X, and forms the foot of a bent lever, L, pivoted at *s* on one arm of the armature, A, A. This armature is pivoted at the centre of the disc, D, about which it swings freely in response to the varying magnetic attraction of the poles, N, S, of the electro-magnet. It is claimed that on account of the manner in which the armature is hung between the poles of the electro-magnet a very slight attraction serves to deflect it, and as the leverage with which the attractive force acts upon the armature decreases as it approaches the poles, the magnetic pull is uniform throughout the entire movement, instead of being subject to a violent variation, as is the case when an armature approaches the poles in the line of the magnetic attraction.

The core of the electro-magnet is wound with two coils, one of thick and the other of thin wire. In the lamps as actually used, the thin wire is wound first upon the core, and the thick coil outside this. The main circuit includes the carbons and the thick wire, the fine coil being in a derived circuit or shunt to the arc. When the lamp is ready for action and the carbons touching, all the current except the little passing through the fine wire coil, goes through the main path, and the electro-magnet is, therefore, strongly magnetised. The armature at both ends is attracted and carries with it the brake, X, which clamps against the inside rim of the disc, D. Any further motion of the armature must then necessarily turn the disc, which raises the upper carbon, thus establishing the arc. Suppose that only the thick wire coil is wound upon the electro-magnet, then as the current weakens through the lengthening of the arc, as the carbons consume, the ends of the armature not being so strongly attracted swing away from the poles of the electro-magnet, and in so doing the carbon is lowered to a slight extent. When it reaches the position in which the upper end of the lever, L, bears against the pin, S^1, the brake, X, is released, and the carbon is free to slide downwards. Since the magnetic attraction is applied in a way to render the device equally sensitive to currents of different strengths, and since, on account of the leverage obtained by the disc, a comparatively feeble current can overcome the weight of the carbon, a small arc can be as readily formed as a large one. The lamp automatically adjusts itself to the current sent through it, and the brake needs no adjustment, as the armature simply moves through a less or greater distance, forming a short or long arc, as the current increases or decreases in strengh. The use of the fine wire coil is explained as follows :—With only the thick wire on the electro-magnet, the light remains constant only as long as the current itself is so. Considerable fluctuations in this current, such as occur when a number of lamps are in circuit, will therefore cause an unsteadiness of the light, unless some arrangement is provided for equalising the variations. This is the duty of

the fine wire coil, which provides a path for the current around the arc, and as the direction of the current through it is in a contrary direction to that passing by the thick wire, it constantly tends to weaken this. When the current greatly increases, the shunt coil takes its share of the increase, thus tending to diminish the excess of current in the thick coil. This appears an odd way of explaining the use of the fine wire circuit, which is simply to partially neutralise the

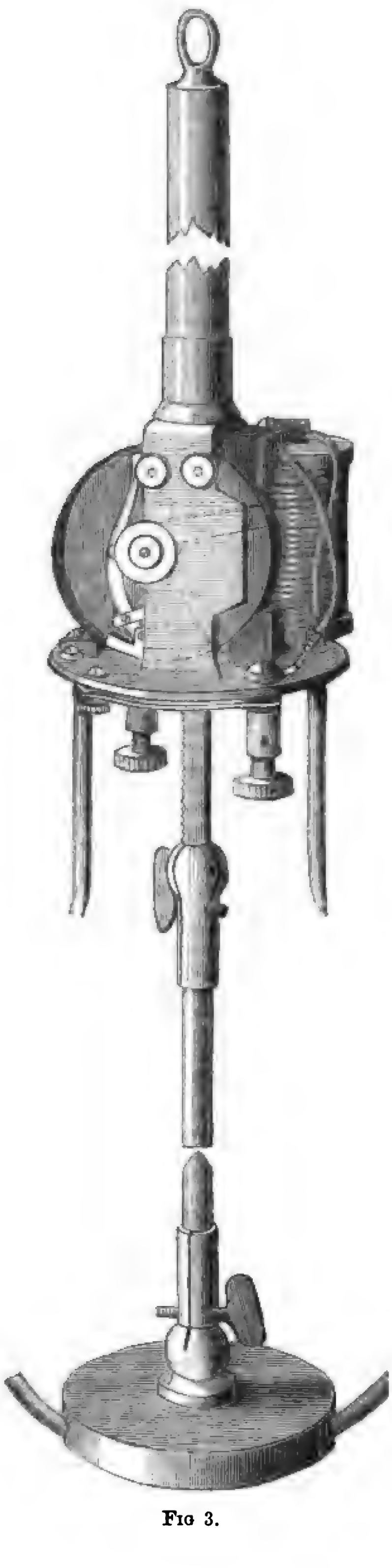


FIG 3.

magnetism developed in the core of the electro-magnet by the current which passes through the thick coil. Of course, if an abnormal resistance should occur in the main circuit of the lamp, the carbons would quickly drop together, and start afresh.

The general view of the mechanism of this lamp is shown in fig. 3.

We are indebted for portions of our description to the pamphlet of the Union Electric Manufacturing Company of New York, and for the last sketch to the courtesy of Mr. Newson, of Isleworth, the agent for the sale of the patent rights of this lamp in Great Britain and Europe, who kindly sent to our office a lamp from which the drawing was made. It would be hard to find a lamp on the arc system, with one carbon above another, to equal this. There is apparently nothing whatever of a delicate nature in its whole construction, and therefore the liability to derangement is reduced to a minimum. The disc, with the friction brake, is a capital arrangement, and it will be seen that *both* poles of the electro-magnet are usefully employed. The use of a shunt circuit for demagnetising or reducing the magnetism produced by the main coil, although not new, is well adapted to its purpose in the Haskins lamp. The nearest approach to this invention which we can call to mind at the moment is the arc lamp of Mr. Andrew Common, who employed a disc and brake, and also a rack and pinion, and a shunt circuit, in opposition to his main coil. The two lamps, however, are in some other points dissimilar, especially in regard to the electro-magnetic apparatus, as in the last-mentioned lamp a solenoid was made use of. The proprietors of the Haskins lamp may rest assured that as far as merit is concerned it should take a leading position, not merely electrically, but commercially; and we can safely say that as far as compactness, simplicity, excellence of design, both electrical and mechanical, and lastly—for such a type of lamp—its extreme lightness, it can certainly hold its own. Having twice seen the lamp, we feel convinced of its superiority in several important points over most of those at present in actual operation.

Since writing our description of Mr. Haskins' lamp, we have received a copy of the following report on its merits. Mr. Farquhar is well known as an expert in electric lighting matters, and his opinion is therefore worthy of consideration :—

DEAR SIR,—In regard to the Diamond Arc Lamp, of which I have made a thorough test and investigation, I may state in a few words its superiority over other arc lamps.

1. The great simplicity of the mechanism used to keep the carbon points at an uniform distance; this same mechanism acting at the same time as the arc starter.

2. The comparatively light weight of the lamp which, complete, does not exceed 10 lbs. I do not know of any other lamp of equal lighting capacity as the one in question, which weighs so little.

3. As regards economy of manufacture, I should state confidently that the Diamond lamp, if manufactured on a large scale, would create quite a revolution in arc lighting, as the small cost of the lamp would overcome one of the great obstacles at present to economic electric lighting.

4. One great and important feature in the Diamond lamp is the relation of the parts and the law of their movements, the effect of which, without entering into details, is such that the lamp automatically adjusts itself to the current sent through it, that is to say, that the arc automatically lengthens if the intensity increases; the lamp therefore acts as a regulator, and affords always a proportional external resistance to the electromotive force of the machine supplying the current; this in a great many instances of practical electric lighting would save serious injury to the dynamo machines.

In conclusion, I may say that after six years of busy employment in practical electric lighting, I have never seen a lamp that recommends itself more to the purpose for which it is intended than the Diamond Arc Lamp.

Yours truly,

—— HEARINGTON, Esq., CHAS. W. FARQUHAR.

374, Euston Road.

17th July, 1882,

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The eleventh session will be held at La Rochelle from the 24th to the 31st of August, 1882. The programme of the session comprises a general inaugural meeting, section sittings, scientific or industrial visits, public conferences, and excursions. Several questions relating to electricity will be treated; amongst others we may mention a paper by M. Marcel Brillouin on the method of comparing co-efficients of induction; the causes of errors and the means of avoiding them; a communication from M. Debrun, Professor at the Lycée of Paris, on a capillary registering electrometer, and the general distribution of electricity. M. Tissandier will expound his researches on small batteries, and M. Hospitalier will hold a conference on the electric light. We shall endeavour to keep our readers well informed concerning the electrical subjects presented to the association.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your issue of the 15th of July, Mr. Henry C. Buck thinks fit to criticise the criticism of M. Le Comte du Moncel, and claims that Professor E. Dolbear was the first to apply the vibrations of a condenser to the construction of a telephonic receiver; but he must have forgotten that Mr. Varley, some years before the invention of the Dolbear telephone, constructed an apparatus in which a Reiss transmitter and a battery were inserted in the circuit with the primary wire of an induction coil, to the secondary of which was attached a condenser, which was found to reproduce sound nearly as well as the Reiss receiver. Thus it would appear that the only improvement made by Professor Dolbear was the substitution of flexible plates for the packed condensers, and the use of a transmitter producing undulatory currents instead of intermittent ones.

Yours faithfully,

F. D. WOLFFERS, FILS.

56, Portland Place, Clapham, S.W.
July 19th, 1822.

CARBONISING PROCESSES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Can you, through the columns of your valuable journal or by letter, give me any information in regard to the Bertholetti process of carbonising? Can you give me the name of any work referring to the subject of carbonising? Very truly yours,

FRED. L. HARRIS.

20, Nelson Square, S.E., *July 25th*, 1882.

[We will endeavour to find the information our correspondent seeks, and in the meantime perhaps some of our readers may be able to supply his wants.—EDS. ELEC. REV.]

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Having read "Disque's" letter and your paragraph in your last issue, I should be glad if you would find room for my experiences.

Having had cause to make complaints (as who had not), I adopted the usual course of writing to the management. This being without avail I requested that a deputation from a certain section of exhibitors should be received by the directors. After some delay a reply was forwarded, stating that the chairman and manager would be pleased to hear us. The usual soft soaping took place, and things became worse than before.

I then wrote to the Lord Mayor, whose name heads the list of the Honorary Council of advice. In due course I received a reply from his secretary to the effect that the Lord Mayor knew nothing of the matter, and had forwarded my letter to the Crystal Palace authorities. Of course, I heard nothing further, and concluded the game was not worth the candle.

All exhibitors should now combine and insist upon the directors making the awards known at once, failing which they should decline to enter for the forthcoming exhibition. The Honorary Council of Advice is much too honorary to be troubled with the matter. Yours truly,

F. W. POPE-COX.

Salisbury Hotel, London, *July 26th*, 1882.

We have received from Prof. Silvanus Thompson an important letter on the subject of the telephone, but unfortunately too late for insertion in the present number.—EDS. ELEC. REV.

NOTES.

KENNEDY'S ELECTRIC-LAMP PATENTS.—With reference to a statement which appeared at page 386 in the "Notes" of our issue dated 27th May last, we are now able to state on authority, that all oppositions to the patents applied for by Mr. Kennedy, No. 5524 of 1881, No. 1199 of 1882, the latter being the "Solenoid Arc Lamp Patent," have been withdrawn. With reference to the latter, it is important to state that the opposition to it was withdrawn after a declaration had been filed by Sir William Thomson, pointing out the important differences in Kennedy's Arc Lamp over any lamp which had preceded it. The only reason we had for stating what we did was the fact that nothing was mentioned concerning this matter in the Company's prospectus. We are glad to note that these oppositions have not led to any difficulties or complications whatever, that both patents are now completed, and the necessary arrangements carried out under them with the Railway and Electric Appliances Company (Limited).

SCIENTIFIC REPORTS ON ELECTRIC LIGHTING.—We drew attention last week to the extract of Mr. J. E. H. Gordon's report on the "Rogers" incandescent electric lamp, which was published in the daily press during the last day or two remaining, for applications for shares in the J. B. Rogers Electric Light Company. We notice the following letter in the money article of the *Times* of Saturday last:—

"28, Collingham Place, Cromwell Road, S.W., July 21.

"Sir,—I observe in the *Times* of yesterday an advertisement of the J. B. Rogers Electric Light Company, in which it is stated that the full report can be seen at the office.

"On sending to the office I find that this is not the case, as only that portion of my report which alludes to the lamps is shown.

"I shall be obliged if you will permit me to state through the *Times* that my report embraced both the incandescent lamps constructed by Mr. Rogers and the 'system of subdivision' patented by him, and that I stated that the so-called system is worthless. About the rest of the nine patents advertised I have expressed no opinion, as they have not been submitted to me.

"Your obedient servant,

"J. E. H. GORDON."

We cordially endorse Mr. Gordon's opinion on the worthlessness of the system of subdivision, and we can only regret that publicity was not given to this matter before the closing of the share list. That, however, is not Mr. Gordon's fault, for the J. B. Rogers Company apparently took care that his disclaimer should not meet the public gaze until it was useless, for the reason above stated. The same letter was also published, we believe, in the *Standard*, and has called forth the following reply, which appeared in that newspaper on Wednesday:—

SIR,—The attention of the directors of this company has been called to a letter in the Money Article of yesterday's issue of your paper, signed J. E. H. Gordon, in which he states erroneously that a certain report made by him on some of Mr. Rogers' patents was omitted from the report produced at the company's offices to his representative. We are directed to inform you that our clients have never had but one report of Mr. Gordon's, *i.e.*, that on Mr. Rogers' Incandescent Lamp, and that has been produced in its entirety to every applicant who has applied to inspect the documents set out or referred to in the prospectus of this company. The directors have made inquiries of Mr. Rogers and the promoters whether or not any other report of Mr. Gordon's has been made on Mr. Rogers' patents, and they find that Mr. Gordon's draft report did contain an opinion on the "System of Distribution" that Mr. Rogers was mistaken in his views on the subject, but that portion of the report was struck out by Mr. Gordon, and omitted in the fair copy report signed by him and received by the directors.

We refrain from further observations pending the result of counsel's opinion as to the course the directors should adopt in consequence of the publication of Mr. Gordon's letter.

We are, Sir, your obedient servants,

WEST, KING, ADAMS, and CO.

Cannon Street, London, E.C., *July 25th*.

THE ELECTRIC LIGHT IN EGYPT.—Lieutenant Dickin, of the *Alexandra*, has succeeded in establishing the electric light at Fort Comeldikh.

THE ELECTRIC "SUN" LAMP AND POWER COMPANY.—It is announced that the letters of allotment for the shares of the Electric "Sun" Lamp and Power Company (Limited) were posted on Wednesday evening.

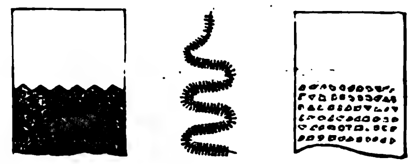
THE ISLAY CABLE.—We understand that the ss. *Morna*, now off Silvertown, will start this morning to repair the above cable.

THE ELECTRIC LIGHT IN THEATRES.—We extract from Thursday's *Standard* the following note from the Paris correspondent of that paper :—"The disastrous fires in theatres, which have lately entailed the loss of so many lives, have induced the Prefect of Police to study the question of lighting places of public amusement, with the view of, if possible, lessening the danger entailed by the use of gas. Till now no very satisfactory result had been achieved. Many experiments with various electric lamps had been made, but all had required the presence in the building of an engine to supply the lamps with electricity. Last night a step was, however, made in the right direction. The Variétés Theatre was lighted up by the English Faure Electric Accumulator Company ; the whole house, the stage, footlights, corridors, and green rooms were all lighted with the Swan incandescent lamp. The intensity of the light was very successfully regulated, and the footlights turned on and off with great rapidity. The heat was also very much less than that occasioned by the use of gas. The spectators at these private experiments, among whom were M. Camescasse, almost every theatrical director in Paris, theatrical critics, and many Deputies and Senators, pronounced most favourably on them."

ANOTHER "BRUSH" COMPANY.—We have received the prospectus of the "Brush" Electric Light Company of Ireland (Limited), which has been formed to supply in Ireland electricity for public and private lighting, as a motive power and for other purposes. It has secured concessions from the Anglo-American Brush Corporation for the use of the rights and patents of the latter. The capital is £250,000, of which £130,000 are to be issued now, in 26,000 shares of £5 each. Two thousand shares will be issued as fully paid to the vendors, who will also receive £22,500 in cash. It appears from the prospectus that the company is to take over the business and plant of the Dublin Electric Light Company (Limited) and 6,370 shares are reserved for that purpose. The company is expected to profit largely by "granting sub-licences to local companies." This mode of operating has, no doubt, worked very well, so far, for the original "Brush" Corporation, but is not, as it appears to us, capable of unlimited development, and unless some more solid and lasting earning capacity than this is possessed by the companies which have made it their chief reliance, their profits will cease shortly. It is, perhaps, too much as yet to expect them to show any very large volume of regular business, but in nearly all the prospectuses of this class of companies which have come before us the principal inducement offered to investors is the possibility of selling a concession to some third party, a legitimate operation enough, but one which *ex vi termini* cannot constitute a permanent source of revenue.—*The Times.*

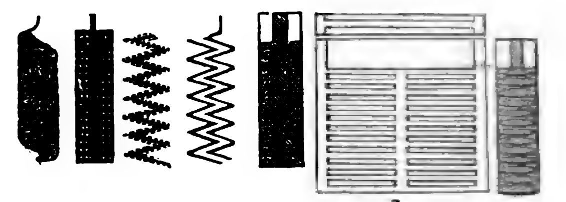
THE HOLBORN GUARDIANS AND THE ELECTRIC LIGHT.—In consequence of the great increase in the gas bill for the infirmary during the last year, notwithstanding that there was a reduction in the price, the board, a short time since, invited tenders for lighting the establishment with the electric light, and the tenders received were as follows : Messrs. Siemens Brothers, £5,000 ; the Brush Electric Lighting Company, £4,345, and Messrs. Pilsen, Joel and Company, £3,143. The Infirmary Committee reported that the matter was referred to Messrs. Snell and Sons, architects to the board, to report thereon. The committee stated that they had awarded the best thanks of the committee to Messrs Snell and Sons for their careful and elaborate report, and the committee report to the board that in their opinion it is not advisable to use the electric light at the establishment. Mr. Ross moved the adoption of the report. It was shown that the expense of the electric light was such that they could not think of adopting it at present. Mr. Whiting thought that the subject had not received proper attention, and that another committee might bring up a more favourable report. The present gas-fittings could be adapted to the electric light, and they would get rid of the vitiated atmosphere. The report was then approved. This matter formed the subject of Mr. Snell's correspondence with several of our contemporaries.

SECONDARY BATTERY.—Patent No. 260,654. Filed in the United States of America Patent Office, June 15th 1882, by Charles F. Brush :—



Claim.—The method of forming the plates of a secondary battery consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plate and within such receptacles, and afterward subjecting the oxide of lead to pressure.

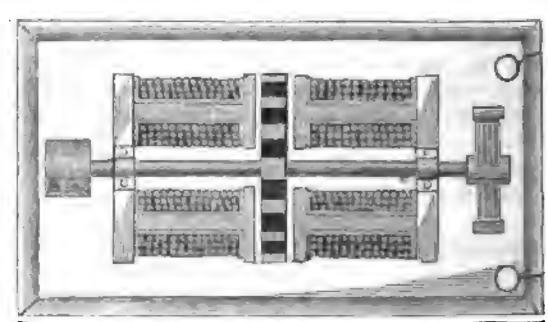
SECONDARY BATTERY.—Patent No. 260,653. Filed in the United States of America Patent Office, June 15th, 1882, by Charles F. Brush :—



Claim.—In a secondary battery, an element consisting of a structure of etagère-like form, containing in the spaces between its shelves lead in a finely-divided state, substantially as set forth.

DYNAMO-ELECTRIC MACHINE.—Patent No. 260,652. Filed in the United States of America Patent Office, June 1st, 1880, by Chas. F. Brush.

Brief.—Surrounds the cores of the field-magnets with a continuous band of sheet copper or other suitable conductor. Over these bands are coiled the magnetising helices in the customary manner, the purpose being to avoid extra currents.



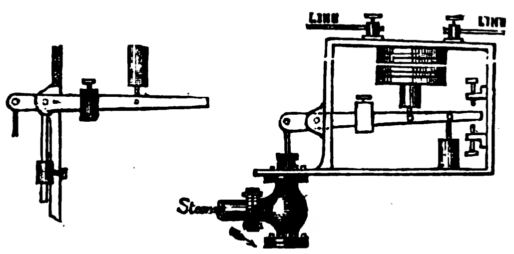
Claim.—1. In a dynamo-electric machine the combination, with the moving coils or bobbins of conductors, of field-of-force magnets having their cores encircled by one or more closed conductors, substantially as set forth.

2. In a dynamo-electric machine the combination of the moving coils or bobbins of conductor within which the electric current is induced, and one or more field-of-force electro-magnets that are surrounded by one or more closed diamagnetic conductors, substantially as and for the purposes set forth.

3. In a dynamo-electric machine, the combination, with the moving coils or bobbins of conductor within which the electric current is induced, of one or more field-of-force electro-magnets that are surrounded by one or more closed diamagnetic conductors, and an exciting helix or helices, also surrounding said field-magnets, substantially as set forth, whereby the insulation of the apparatus is preserved during fluctuations in the current exciting said field-magnets.

INCANDESCENT ELECTRIC LAMPS WITH CARBON FILAMENTS.—We have heard on very good authority that the Edison Electric Light Company has resolved to apply for an injunction against the Swan Electric Light Company, on the ground that the Swan lamp is an infringement of the Edison patents. The case is to be decided before Mr. Justice Chitty, we believe, and indeed, unless other arrangements have been arrived at in the meantime, the case may have been heard before this meets the eyes of our readers. Should the intention of the first-named company be carried out, it will be interesting to see whether the result will be of a like character to the recent telephone trial.

CURRENT GOVERNOR FOR DYNAMO-ELECTRIC MACHINES.—Patent No. 260,650. Filed in the United States of America Patent Office, June 29th, 1880, by Charles F. Brush.



Brief.—An axial magnet in the main circuit controls a lever connected with the valve, which admits steam to the engine which drives the generator.

Claim.—1. In a system for generating and applying an electric current, the combination of the following-named instrumentalities, to wit: A dynamo-electric machine, a motor for driving said dynamo-electric machine, an external or working circuit upon which is placed one or more electric lamps, electro-motors, or any device to be operated upon or actuated by the electric current, and a governor consisting of a hollow or axial magnet that is energised by current from said dynamo-electric machine, and that is associated with suitable valve or cut-off mechanism, said governor constructed and adjusted to control the speed at which the dynamo-electric machine is driven, according to the varying condition of the current in said external or working circuit, substantially as shown.

5. In combination with an electric governor for regulating the speed at which a dynamo-electric machine is driven, the pendant weight substantially as and for the purpose shown.

ELECTRIC LIGHT AT BEACONSFIELD HOTEL, ADDISON ROAD STATION.—We understand that Mr. W. Cooke, the proprietor, intrusted the installation of the electric light in the above hotel to Messrs. Charles Powis & Co., of Millwall Pier and 60, Gracechurch Street, engineers and electric light contractors. The entrance lobby, bar, and billiard room (containing two full sized tables) are brilliantly lighted with eighty Swan incandescent lamps, and the exterior with a Siemens arc lamp. A Siemens alternating current dynamo-electric machine, driven by an eight horse-power (nominal) gas engine, is fixed in the basement. This installation, which is said to be a permanent one, was officially started on the evening of Saturday, the 15th inst. (the opening day), in a most satisfactory manner, and was witnessed by a large number of Mr. Cooke's friends and customers, who were present during the whole of the evening and expressed themselves highly satisfied at the steadiness and brilliancy of the light.

CHESTERFIELD AND THE ELECTRIC LIGHT.—At a meeting of the Chesterfield Town Council last week a letter was read from the Hammond Electric Light and Power Supply Company asking, in view of the passing of the Electric Light Bill now before Parliament, for the consent of the corporation to run wires under the streets of the borough for the purpose of private lighting. The Mayor pointed out that the request was one of very great importance, for compliance with it would give the company a monopoly of public and private lighting by electricity in the borough. After some discussion it was agreed to refer the application to the Watch Committee.

THE INSURANCE AND THE ELECTRIC LIGHT.—It is reported from America that the fire insurance companies of Philadelphia have decided to cancel policies wherever they find electric conducting wires attached to the roofs of buildings on which they have outstanding risks.

THE ELECTRIC LIGHT AT SYDNEY (N.S.W.)—At a recent meeting of the City Council of Sydney a proposal was received from a London gentleman interested in the formation of syndicates, offering to light the streets and public buildings of Sydney by electricity at a cost of 25 per cent. less than the contract price of the gas now supplied.

THE AUSTRIAN REGULATIONS FOR THEATRES.—From the new Austrian Regulations for Theatres we extract the following:—Electric light: When a theatre is lighted by electricity the installation must be arranged so that the illumination of the auditorium is wholly independent of that of the stage. In all the parts of the theatre the installation must provide two separate systems and independent circuits, each with its lighting machines and apparatus. The wires must be sufficiently stout to prevent their being overheated; they must be carried along a groove in the wall, and secured against being injured, as well as against the possibility of the audience coming in contact with them. The electric light must be provided with glass globes, and so fixed that it is impossible for particles of the carbon points to fall out. Motors driving the machines must in cases where fire is employed in them be fixed up outside the theatre building. Fire telegraph: The theatre should be connected with the local fire brigade by telegraphic signalling apparatus which should be accessible not only in the parts of the house frequented by the *personnel* of the theatre, but also in the offices and the porter's lodge. The apparatus should be fixed near the mechanism for moving the fire-proof curtain, and attended to by the watchman looking after the latter. A similar apparatus should be placed in the offices and porter's room. The telegraph must be tested every day about noon, so that in case it should get out of order there may be plenty of time to repair it.

THE BRUSH ELECTRIC LIGHT AT WORCESTER.—The Fine Art Court at the Worcester Industrial Exhibition is illuminated by Brush lamps supplied by the Birmingham and Warwickshire (Brush) Electric Light Company, and the installation is, we understand, giving great satisfaction.

GAS MANAGERS AND THE ELECTRIC LIGHT. — The twenty-first annual meeting of the North British Association of Gas Managers was held in Edinburgh on the 21st inst., The president, in the course of his address said, "it was abundantly evident that cheaper gas must be made and supplied, and to accomplish this their energies must be at once directed. Economy must be the order of the day, and he was persuaded they should not be found lacking in the desire to inquire into and take advantage of such new or improved methods as might be devised and submitted to the profession for use. He did not say this because he feared the electric light, which, so far as he was able to judge, would never become commercially a rival of gas. He would rather hail "the light of the future" as a mission which had taught them what they were capable of accomplishing with gas, as was everywhere apparent in improved lighting. He was satisfied, too, that wherever electricity and gas were brought into competition, it had been well substantiated that gas was able to hold its own, as regarded cost, convenience, or reliability, and even, he would say effectiveness of illumination. At a subsequent meeting Mr. Donaldson described a ventilating globe light. He claimed that where these globes are used, the gas burned in them ventilates the room it illuminates, and in a sanitary point of view is superior to the electric light.

IMPROVEMENTS IN ACCUMULATORS.—In these times of new electrical companies we cannot too strongly recommend to capitalists the particularly ingenious method discovered by M. C. Blanchart, honorary engineer of the mines at Brussels, of obtaining electric accumulators of a capacity far superior to any that have been made at present—on paper, that is. We know that, according to the experiments of Sir W. Thomson, and those of MM. Tresca, Joubert, and Pothier at the Conservatoire des Arts et Métiers, at Paris, the Faure accumulators can store up work equivalent to one horse-power during one hour, with a weight of about 75 to 80 kilogrammes, or 4,000 kilogrammetres per kilogramme of accumulators under the most favourable conditions. M. Blanchart arrives at the figure of 11,371 kilogrammetres with his improved accumulators. Only—there is an only—M. Blanchart in his calculations only takes into account the weight of the lead and of the minium—the vessel and the acid are not reckoned—and besides, he says that the discharge is effected with a *constant* electromotive force of 2·15 volts, which is incorrect, since the intensity of the current through an unknown resistance at the commencement of the discharge is 13·33 ampères, and at the end it is only 8 ampères. This change

in the intensity is not produced without a decrease of electromotive force, but it is convenient not to take this into account in the calculations because it increases the total result. But there is still more to be said. M. Blanchart, by reckoning the weight of the oxidised plates only, and ignoring the fall of potential during the discharge, arrives at the fantastic figure of 23,600 kilogrammetres per kilogramme of active material. It seems to us, however, that the reduced lead which becomes oxidised during the discharge, may also be considered active material. Adopting M. Blanchart's method of calculation, rather less than 12 kilogrammes of active material were sufficient to produce one horse-power-hour of electrical energy. We sincerely hope this is the case, but it is impossible to accept it merely on the calculations of the inventor, who, aiming at simplification, ignores to too great an extent important factors. In conclusion, we may add for the benefit of those who may intend to verify our remarks, that M. Blanchart's calculations are given at length in the *Annales de l'Electricité* for July 15th, 1882, page 204.

THE ELECTRIC LIGHT.—Referring to the discussion which took place in the House of Commons on Saturday on the Electric Lighting Bill, the *Daily Chronicle* remarks that the gas companies may claim our sympathy if they are damaged by the new illuminant, but if their pretensions are eclipsed they must be satisfied with sympathy. If the new invention surpasses gas the public interest must override all sentimental ideas about vested interests. The gas companies have no vested interests; they have for many years enjoyed a monopoly in the lighting of public places, but they enjoyed that monopoly for the simple reason that their light was the best which could be procured. The advances made of late years by the electric light have produced a most beneficial effect upon the lighting of the London streets. But the recent exertions of the gas companies cannot prevent the progress of the new illuminant, and we are glad to find that the Government are determined that, so far as they can, they will secure for it a fair trial. Parliament has no right to consider the interests of the gas companies apart from the public convenience, and therefore local authorities will have an opportunity of adopting the new illuminant if they think fit. It would be absurd to suppose that this Bill will dispose of the opposition of vested interests. The electric light will have to fight its own way, and before it gains the goodwill of local authorities it will not only have to prove its superiority, but to overcome the private prejudices which the long-vested interests of gas have planted in every populous part of the country. As to the second objection to the Bill, we do not believe that the local authorities will be found to be at all too ready to rush into expense for the purpose of introducing the electric light. On the contrary, we expect rather to find a disinclination to admit the new illuminant.

CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.—The India-rubber, Gutta-percha and Telegraph Works Company notify the receipt of telegrams from Mr. R. K. Gray, engineer-in-chief, announcing the successful completion of two more sections by the ss. *Silvertown*, namely, from Salina Cruz, near Tehuantepec, Mexico, to Libertad, in San Salvador, and from Libertad to San Juan del Sur, in Nicaragua.

It would appear, therefore, that an alteration in the landing places has taken place. Instead of landing at San José de Guatemala, as was first intended, the Salina Cruz section now lands at Libertad, and thereby brings the republic of San Salvador in the company's system of cables.

The cable was further supposed to have gone from San José to Salinas Bay, in Costa Rica; but this section is now replaced by the Libertad—San Juan del Sur section, and through this the republic of Nicaragua enters the company's system.

Libertad is the principal harbour of San Salvador, and is connected by a good road with the capital, some fifteen miles distant. The capital is the city of San Salvador, founded in 1528, by George Alvarado. The city was, however, repeatedly destroyed by earthquakes and volcanic eruptions, the last time on April 16th, 1854. The inhabitants then erected new dwellings on a neighbouring site, at present called Nueva San Salvador. But this new capital again was partly destroyed in 1873, by a series of earthquakes and simultaneous eruptions of the neighbouring Tzalco volcano.

Nicaragua is also rich in volcanoes. The old capital of the republic is the city of Leon, some ten miles from the Pacific, surrounded by five active volcanoes, and partly in ruins. At present the seat of the Government is the town of Managua, situated on the southern border of the great lake of the same name. This town is but provisional, being built on the slope of an active volcano, and liable therefore to instant destruction.

No doubt these two countries will open a splendid field for the study of earth currents.

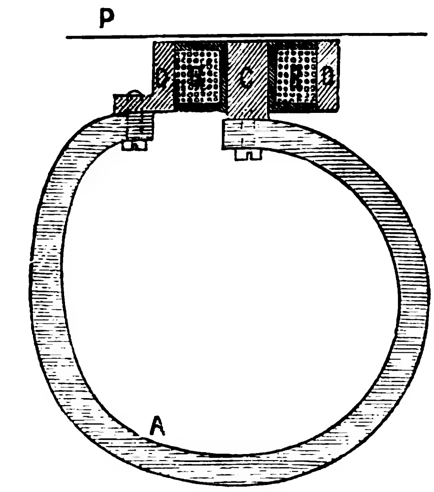
A NEW RED SEA CABLE.—The ss. *Rochefort* was to leave the works of Messrs. Siemens Brothers, on Wednesday, the 26th inst., with the above cable. The contract was made on account of the Turkish Administration of Telegraphs. The length is about 200 nautical miles, and it will be laid from Jeddah, in Turkey, to Souakim, in Egypt. The cable is somewhat similar in type to that of the Black Sea cable of the Eastern Company.

TELEGRAPHIC COMMUNICATION WITH INDIA.—A letter from Colonel F. Burnaby appeared in one of last week's issues of the *Times*, calling attention to the fact, "that in the event of our relations with the Porte being broken off England's telegraphic line of communication with her greatest possession—Hindostan—would be liable at any moment to be cut. Passing, as the wires do, one through Constantinople and Bushore, another through Odessa and Teheran, and the remainder *via* the Delta and India, we are practically dependent upon our friendly relations with the Mahomedan States for our electric communications with Hindostan. The Cape of Good Hope is united by wire with Aden and Bombay; Lisbon is connected with Cape de Verde. Would it not be wise without delay to continue that line through St. Helena to the Cape, thus making us independent of any hostile Mahomedan combination?" In the House of Commons on Friday week, Mr. Leigh asked the Postmaster-General if his attention had been directed to the above letter and if he would take steps to carry out the suggestion and so put our communication beyond the control of hostile Mahomedans? Mr. Fawcett, in answering, stated that the submarine ocean telegraphs are not under the control of the Post-office; that the question forms one of general policy, and that he scarcely felt competent to reply.

THE HOUSE OF COMMONS AND THE TELEPHONE.—In the House of Commons on Thursday week Mr. Shaw-Lefevre, in reply to an interrogation, stated that he would endeavour during the recess to place the House of Commons in telephonic communication with the Telephone Exchange. The only difficulty to encounter was the getting of a suitable room.

M. A. D'ARSONVAL'S TELEPHONE, WITH CIRCULAR MAGNETIC FIELD.—This new form of magnetic telephone was presented by the inventor at the last sitting of the French Physical Society on the 21st of July. M. d'Arsonval was led to adopt this arrangement by studying the effect produced by a wire traversed by an electric current on a double pole telephone (of the Gower, Siemens, or Ader type), without coils. Placing the wire in every position between the poles, internally, laterally, &c., he found as might be expected, that the maximum of effect is obtained when the wire is in that position where the magnetic field is greatest, *i.e.*, between the two poles of the magnet. It is in order to increase the useful part of the wire, which is placed between the arms of the magnet, that the Gower and Ader telephones are furnished with flattened poles. M. d'Arsonval asked himself whether, with a suitable method of coiling, it would not be possible to suppress entirely the outer part of the wire, which introduces into the circuit a supplementary resistance without much useful effect of importance. He effected this by constructing a telephone

with circular magnetic field, similar to Nicklés' electro-magnets. The apparatus shown in the accompanying diagram resembles in its outward form an Ader telephone. The bent magnet, A, forms a handle; on one of the poles is fixed a cylindrical core, C, of soft iron, on the other a ring of soft iron, D, enclosing the first; the coil, B, is placed in the annular space which is left free between these two circular poles. The magnetic field is thus concentrated into the space occupied by the coil, and the lines of force are turned into a direction perpendicular to the wire of the coil. When the telephone is employed as a transmitter, the movements of the plate, P, produce a sort of pivoting



of the lines of force, which gives rise to induction currents. When the telephone is employed as a receiver the undulatory currents which traverse the coil produce a maximum of effect, since they act in that part where the magnetic field is most intense; the modification which they bring to bear on the continuation of the lines of force re-act upon the plate and make it vibrate. With much less weight and a much shorter wire—M. d'Arsonval's telephone weighs 125 grammes, and has only 20 ohms of resistance—we obtain effects as powerful as those produced by the Gower telephone, but with more clearness.

The Gower telephone being furnished with an ear-piece, produces a sound like that heard in a sea-shell, which M. d'Arsonval attributes partly to the too great diameter of the tube and partly to the spiral of metallic wire placed in the tube in order to prevent its becoming flattened. M. d'Arsonval has obviated this difficulty by using a simple tube of gutta-percha eight millimetres (one-third of an inch) in diameter, and thus all resonance is destroyed. It is advantageous in practice to arrange a double tube, one for speaking and the other for hearing.

FRENCH PHYSICAL SOCIETY.—The last sitting of the season took place on Friday, July 21st. The meetings are adjourned during the vacation to November next.

SPECIAL ANNOUNCEMENTS.—We desire to call the attention of our readers to several special announcements at page 10 of supplement.

NEW COMPANY REGISTERED.

ELECTRICAL APPLIANCES SYNDICATE, LIMITED.—Capital £5,000, in £10 shares, with power to increase to £20,000. Objects: To carry on the business of mechanical and electrical engineers and boiler manufacturers of an electric light and power company. Signatories (with one share each): W. Harman, 99, Gresham House; R. Jenkin, 25, Bond Street, Vauxhall; G. S. Ullathorne, C.E., 1, Rutland Road, Hammersmith; S. Crosse, 49, Holland Road, Brixton; R. Soutter, Richmond; H. T. Turner, 106, Vauxhall Bridge Road; H. Ponché, 3, Wilmington Square, W.C. The signatories are to nominate the first directors. Qualification, £100 of share capital. Registered 19th inst. by A. S. Ramskill, 7, Union Court, Old Broad Street.

NEW PATENTS—1882.

3430. "Application of telephones or microphones to pipes or vessels containing and conveying liquids, fluids, gases, and air, for the purpose of detecting leakage therefrom." A. Q. ROSE. (Communicated by F. J. Bell.) Dated July 19.

3433. "Means of operating microphones." P. M. JUSTICE. (Communicated by F. van Rysselberghe.) Dated July 19.

3434. "Electric meters." C. V. BOYS. Dated July 19.

3441. "Apparatus for regulating electric lamps and for measuring electrical currents and electrical energy." A. and F. GRAY. Dated July 20.

3443. "An improved medical battery." W. R. WARREN. (Communicated by G. M. Hopkins.) Dated July 20. *Complete.*

3455. "Dynamo and magneto-electric machinery." J. S. BEEMAN. Dated July 20.

3458. "Telephonic apparatus." J. E. CHASTER. Dated July 20.

3464. "Improvements in secondary batteries or in apparatus for storing electricity." J. H. JOHNSON. (Communicated by J. H. Sutton.) Dated July 21.

3465. "Accumulation and distribution of electricity." L. H. M. SOMZÉE. Dated July 21.

3466. "Improvements in the means or apparatus for generating electric currents and producing motion by electricity, and for regulating electric currents and making and breaking circuits." C. A. CARUS-WILSON. Dated July 21.

3473. "Apparatus for generating, utilising, and regulating electric currents for lighting and other purposes." A. RECKENZAUN. Dated July 21.

3476. "Chambers and receptacles for electrical apparatus." W. A. BARLOW. (Communicated by L. Encausse.) Dated July 21.

3485. "A new or improved method of and apparatus for telegraphing to and from a railway train in motion." W. B. HEALEY. (Communicated by W. L. Hunt.) Dated July 22.

3504. "A new or improved machine for generating electricity." A. D'ORELI. Dated July 24.

3508. "Electric lamp." A. M. CLARK. (Communicated by H. J. Müller and A. Levett.) Dated July 24.

3510. "Means and apparatus for obtaining motive power by electricity." J. BARLOW. Dated July 24.

3513. "Telephones." S. BIDWELL. Dated July 25.

3515. "Distributing and diffusing powerful lights." A. P. Trotter. Dated July 25.

3520. "Arc electric lamps." A. L. LINEFF. Dated July 25.

3528. "Secondary batteries, or storage batteries, and method of, and means for, charging and discharging the same." C. E. BUELL. Dated July 25.

3532. "Secondary or polarisation batteries for the storage of electrical energy." G. L. WINCH. Dated July 25.

3534. "Dynamo-electric machines, or electric generators, and electro motors." O. W. F. HILL. Dated July 25.

3544. "An improved electric regulator and meter." W. LAING. Dated July 26.

3547. "Electric cables." J. G. LORRAIN. (Communicated by J. André.) Dated July 26.

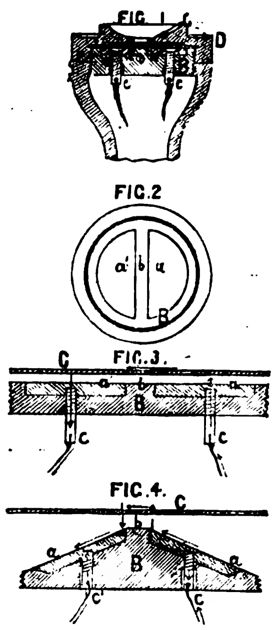
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

5407. "Manufacture of compounds for electrical insulation." W. ABBOTT and F. FIELD. Dated December 10. 2d. The insulating compound of ozokerit and india-rubber, prepared according to Field and Talling's Patent, No. 1938, of 1875, has the disadvantage of being more or less soft, and therefore not suitable for all purposes. Attempts have been made to vulcanise this compound in the ordinary manner, that is to say, by mixing therewith the vulcanising agents, but this process has been found to deteriorate the insulating properties of the compound and to interfere with its applicability for covering wires. Now according to the present invention the inventors produce a perfectly vulcanised covering for telegraph wires and similar purposes, by first covering the wire with the said compound of ozokerit and india-rubber, and then surrounding such covering with a layer of india-rubber with which an excessive quantity of sulphur or other vulcanising agent has been incorporated; the compound covering so prepared is then subjected to heat such as is usually employed for effecting the vulcanising operation, whereby the compound of ozokerit and india-rubber will become thoroughly vulcanised by means of the excess of vulcanising material in the surrounding covering, resulting in the production of an improved insulating covering consisting of a core or inner layer of vulcanised ozokerit and india-rubber compound surrounded by an outer covering of vulcanised india-rubber. (*Provisional only.*)

5418. "Arrangement of electrical apparatus on railway trains." J. E. LIARDET and T. DONNITHORNE. Dated December 10. 6d. Relates to the arrangement of electrical apparatus on railway trains. The inventors mount dynamo-electric machines upon railway carriages in such manner that the said machines can be set in motion when the train is at a suitable speed and then made to generate electricity, which is stored in secondary batteries and applied when required for lighting the train for signal lights and for propulsion where desired.

5430. "Telephones." A. W. ROSE. Dated December 12. 4d. Consists in the employment of a compound diaphragm, the central portion of which is made of a thin material, and the outer portion of a comparatively thick material, by which is obtained a more effective action of the diaphragm, the thinner portion first yielding to the full extent allowed by its elasticity, and then evoking the action of the thicker portion, which then comes into play, and co-operates with the thinner portion of the compound diaphragm.

5431. "Telephones." A. W. ROSE. Dated December 12. 6d. Relates to the receivers of telephones of that class in which articulate sounds are received by disturbing the statical charge of a circuit. One mode of constructing receivers of this description has been to fit two plates or diaphragms at a short distance from each other, in a suitable case, one of such plates being connected with the secondary coil of an induction coil, and the other plate with earth. According to the present invention, the inventor employs a rigid disc, divided into two parts, which are separated by insulating material, and he connects one half of the disc with the secondary wire of an induction coil, and the other half with earth, or with a return wire, when metallic circuits are used. Opposite this divided disc is a metal diaphragm, secured at its edges, and arranged at a short distance from the disc. The secondary current passes from line to one half of the disc across to the diaphragm, and back to the other half of the disc, and thence to earth, or to the return wire, as the case may be. By this means two positive semi-vibrations of the diaphragm are obtained for each electric pulsation, and thus a louder and better articulation from the receiver is obtained. Fig. 1 represents a section



of a telephonic receiver constructed according to the said invention. Fig. 2 is a plan of the same, with the mouthpiece removed. Fig. 3 is a diagram sectional view, drawn to an enlarged scale, illustrating the direction of the electric current. In figs. 3 and 4 the distance between the divided disc and diaphragm is exaggerated, for the sake of clearness of illustration. a a^1 are two rigid half discs of conducting material, which are separated by an insulating strip, b, the latter being either formed in one, with a carrier-piece, B, of non-conducting material, as shown, or attached to the said carrier piece. One of the half-discs, say, for example, the half, a, is connected with the secondary wire of an indication coil by a terminal, c, and the other half-disc, a^1, is connected by a terminal, c^1, with earth, or with a return wire, when metallic circuits are used. Opposite the two half discs, a a^1, is a metal diaphragm, C, secured at its edges by the mouthpiece, D, so as to be situate in very close proximity to the half discs, a, a^1, without being in actual contact. The secondary current passes from the line to the half disc, a (*see* fig. 3) across to the diaphragm, C, and back to the half disc, a^1, and thence to earth, or to the return wire, as the case may be.

5432. "Telephones." A. W. ROSE. Dated December 12. 4d. Relates first to the microphonic transmitter of telephones and consists in the combination with the compound microphone of a thin vibrating diaphragm of mica or other suitable material. The whole of the carbon buttons of the microphone may be placed in contact with this diaphragm, or the central carbon button only may be in contact with the diaphragm, the surrounding carbon buttons being in contact with the frame. When the diaphragm is composed of iron or other conducting material, it should be insulated from the microphone. By the use of a thin vibrating diaphragm in substitution for the rigid wooden board ordinarily employed, the instrument is rendered more sensitive and the strength of the articulations produced at the receiver is greatly increased.

5445. "Galvanic batteries, &c." O. C. D. ROSS. Dated December 13. 4d. Relates to improvements in galvanic batteries and to the application of such batteries to those electric lamps in which the light is produced in a vacuum glass by the incandescence of a continuous carbon conductor or bridge, and the principal object of the invention is to facilitate the use of the recently invented incandescent lamps by a reduced expenditure on plant and in places and circumstances, such as arise in country mansions, &c., and other places where the lamps cannot advantageously be supplied with electricity by the employment of dynamo electric machines or from secondary storage batteries (Faure's accumulators), which have hitherto been generally considered as the only ways of utilising them. The first part of the invention consists in the construction of a battery occupying but little space, which is very economical and, at the same time, of great power and permanency. The negative and positive elements are platinised broken carbon and amalgamated zinc, which latter is prepared in a comminuted form by pouring it when in a molten condition into water and afterwards amalgamating it in a solution of mercury. Sometimes one or the other of these elements is used in the ordinary form, that is to say, the comminuted zinc is connected with a plate or rod of carbon, or the platinised broken carbon connected with a rod of zinc; and, instead of the ordinary separate cells, a number of cells are combined in a larger vessel, which may be round or square, in which the cells are formed by means of partition slabs, which should be of porous and of impermeable material alternately, or of either of these materials alone. The second part of the invention consists in the combination of galvanic batteries with the above described incandescent lamps, when fitted upon such stems or supporters as will allow of their being shifted about as reading lamps, or of being used as ornamental drawing, or dining room, or hall lamps, or as shop lamps. Any kind of galvanic battery may be employed, but especially such batteries as above named, and batteries in which chromate or bichromate of potash forms the main basis of the solution used to excite either of the zinc and carbon elements. The third part of the invention consists in an arrangement of the vacuum incandescent lamps on their stands, which will allow of their being occasionally taken from the stand and moved from place to place and to a short distance without extinguishing the light. This is effected by attaching a sufficient length of flexible insulated wire between the vacuum glass and the battery, to allow of such removal taking place without interfering with the continuous current of electricity.

5451. "Secondary batteries." J. PITKIN. Dated December 13. 6d. Relates to improvements in secondary batteries or accumulators, and its object is to enable a greater amount of energy to be stored in, and consequently a greater quantity of electricity to be furnished by, electrodes of given dimensions, and at the same time to greatly decrease the weight of the electrodes as compared with that of those formed of plates of lead as usually employed in batteries of this description. The invention consists in forming the electrodes of a mass of very thin turnings or shavings of lead or strips, shreds, or pieces of lead foil or highly laminated sheets of lead in a crumpled condition packed in suitable open frames, preferably of wood or ebonite, and each having a covering of felt, flannel, or other suitable porous material stretched over it on each side to retain the lead in place and allow it to be acted on by the acidulated liquid in which the electrode is immersed.

5452. "Apparatus used in connection with electrical batteries for charging the same, &c." W. R. LAKE. (A communication from abroad by J. F. Aymonnet, of Paris.) Dated December 13. 8d. Relates to apparatus for charging and discharging the liquids in batteries.

5468. "Telegraph or telephone conductors." J. IMRAY. (A communication from abroad by J. M. Stearns, junr., of Brooklyn, America.) Dated December 14. 4d. Relates to the construction and arrangement of cables or grouped conductors for telegraphs or telephones, in such a manner as to prevent the interferences resulting from induction which the passage of an electric current along any one of the group causes in others of the group lying closely adjacent to it. For this purpose a thin sheet of metal, such as copper, having high conductivity, is folded up along with the insulated conductors in a zigzag manner, so that portions of this metal are everywhere interposed between each insulated conductor and those next to it. This metal sheet being at numerous points connected electrically to earth or other discharging conductor, or to the metal pipe in which such cables are often inclosed, carries off induced currents, so that the passage of electricity through any of the grouped conductors does not induce currents in others of the group. Sometimes the insulated conductors are carried in parallel lines along the wall; in such a case the metal sheet can be folded to and fro and passed either in single or in double folds between each adjacent pair and partly round each, and finally over the whole. When the conductors are grouped so as to form a cable, the sheet can in like manner be so undulated or zigzagged as to form a series of loops, each inclosing one of the conductors, which is thus separated by metal from those adjacent to it.

5470. "Galvanic batteries." C. MAURIS. (A communication from abroad by Achille Thomas of Nantes). Dated December 14. 2d. Has for its object improvements in galvanic batteries. The elements of the battery are of zinc and carbon or it might be of copper or other electro negative metal. Their form is that of semicircular discs and they (especially the zinc elements) are perforated with numerous holes to increase the area of the surfaces exposed to electro chemical action. The elements are fixed upon an axis from which they are electrically insulated. This axis passes longitudinally through a box or case which is divided interiorly into cells by a number of partitions extending from the bottom up to the axis. Each cell receives two zincs and one carbon or electro-negative element. The box is lined with bituminous cement or otherwise so as to render it water tight. Within each cell or compartment of the box there is a vessel of porous earthenware, into which the carbon or negative element is received, and this vessel has a cover which may be of glazed earthenware. The negative elements are thus enclosed each within its porous vessel and its cover and there is room in the enclosure to permit of the axis turning and carrying the elements round with it. The lower part of the box is charged with sawdust saturated with water acidulated with sulphuric acid. This is in contact with the zincs.

5481. "Secondary batteries." DESMOND GERALD FITZ-GERALD. Dated December 14. 4d. Consists in the use of carbon in conjunction

with lead or compounds of lead, for the electrodes of secondary batteries. In carrying the invention into effect the inventor constructs plates of carbon with perforations, grooves, or recesses which are filled with lead, preferably in a state of fine division, or with any suitable compound of lead. The pores of the carbon also are filled with the same material, which in this case more especially may advantageously be produced by the decomposition of a salt or of an oxide of lead.

5490. "Electric lamps." W. R. LAKE. (A communication from abroad by Jean Auguste Mondos, of Neuilly, France.) Dated December 15. 6d. Relates to electric lamps of that class in which no clockwork is employed for controlling the movement of the carbons, the electric current being utilised for effecting this movement. According to this invention two successive movements are imparted to the carbons, the first being a sudden movement which separates the carbons and causes the electric arc to be developed, and the other a movement which takes place in proportion to the wear of the carbons and maintains them at the proper distance from each other.

5494. "Secondary voltaic cells." J. W. SWAN. Dated December 15. 2d. Has for its object the preparation of lead plates, to be used in the construction of cells for secondary batteries upon the principle proposed by Planté, with a view to diminish the time usually occupied in their preparation. In carrying out the invention, the inventor takes plates of lead of any suitable form, but preferably corrugated, grooved or cellular plates as described in specification 2272, dated May 24, 1881, and exposes them to the combined action of acetic acid, carbonic acid, and atmospheric air, as in the well-known process of making white lead; which action results in the formation of carbonate of lead on the lead plates. This formation may extend to a depth greater or less according to the time such plates are subjected to the vapours and gases. After this action has taken place to a sufficient depth, a portion of the plate being generally allowed to remain unacted upon, the inventor subjects the treated plates to the action of electrolytic hydrogen by making them the cathode of an electric generator (which may either be a voltaic battery, a dynamo or magneto-electric machine, a thermopile or any other suitable electricity generator in a suitable electrolyte). When the carbonate of lead has been transformed into metallic lead by the said electrolytic action, the plates so treated are used in the well-known manner of arranging and using lead plates in the construction and charging and use of Planté secondary cells.

5499. "Measuring and recording electric currents." J. W. SWAN. Dated December 16. 4d. In the patent dated December 1, 1880, No. 5004, the inventor described an electric meter intended chiefly to be used in connection with electric lamps. The apparatus described in the said specification is so constructed that it is necessary to have a pair of wires extending between the meter and each of the lamps. The present invention is in part an improvement in that apparatus, the improvement consisting in the avoidance of the branch wires from individual lamps. The inventor accomplishes this object by taking the main conducting wire, or a shunt from it, round the several electro-magnets, which determine the engagement or disengagement of the intermediate pawls with the counting mechanism and adjusts the springs which counteract the pull of these electro-magnets, so that when the current for the supply of one lamp is passing through the main wire or shunt only one of the magnet armatures will be attracted from its inactive position, and when current is passing for the supply of more than one lamp the number of magnet armatures rendered operative shall correspond with the number of lamps lighted.

5521. "Secondary or polarisation batteries for storage of electric energy." G. GROUT and W. H. JONES. Dated December 17. 4d. The first part of this invention relates to a preparation or combination of lead or other metal with carbon prepared, as hereafter described, to construct the elements of secondary or polarisation batteries for the storage of electric energy. The second part relates to the application of metallic lead dust to be used to cover, to heap around, or compress upon, the blades or plates of whatever nature used as the core or conductor of the elements of these batteries.

5536. "Dynamo-electric machines." J. E. H. GORDON. Dated December 17. 6d. Relates to improvements in dynamo machines and particularly in that described by the inventor in specification No. 78, 1881. In the machine described in that specification the revolving rings each carry the same number of magnet coils as the fixed rings carry armature coils, the drawings annexed to the specification show them as each carrying 16 coils. The armature coils were also made cylindrical and of the same diameter as the magnets, each being placed close to the next. The inventor has found that these coils act on each other by mutual induction in a very injurious manner during the working of the machine. If a certain number of lamps are being maintained by one coil, closing the circuit of the next to it on one side reduces the light of the lamps on the first by some 20 or 30 per cent.; closing the circuit of the next of the other side still further reduces it by a like amount. The reason is that as the currents in contiguous coils circulate in opposite directions they are in the same direction in those parts of the two coils which are immediately contiguous to each other. As the currents in the two coils are both increasing at the same time they retard each other by their mutual action. In the arrangement of the machine which is the subject of the present patent, this drawback is got rid of by making the number of armature coils twice the number of the magnet coils. The magnets therefore act alternately on the alternate set of coils.

5542. "Galvanic battery." W. R. LAKE. (A communication from abroad by La Société Universelle d'Electricité Tommasi, of Paris.) Dated December 17. 6d. Has for its object an improved galvanic battery which is advantageous as compared with other batteries in respect of its small volume, its great effective surface, and its slight internal resistance. The said improved battery works with one liquid only, the copper and zinc elements are separated by a porous diaphragm, and the jar or vessel which encloses the elements of the battery contains crystals of sulphate of copper; it therefore belongs to the same class as that known as the "Daniell" battery. The invention is based essentially upon two features; that is to say, one feature is the employment of the zinc and copper metals in the form of wires, having a diameter of about 5 to 7 millimetres, twisted spirally or arranged in parallel lines, joined by curves or rounded parts when the vessel used is of square or rectangular form. One extremity of these wires protrudes outside of the said vessel and is bent horizontally to be directly coupled to the corresponding wires of the other elements in order to constitute a battery, which thus can be made up to any quantity and tension desired. The other feature is the replacing of the porous cylinder or vase generally used in the construction of the "Daniell" battery by a sheet of parchment or dyalised paper, arranged horizontally, and the edges of which are plaited or folded, and rise above the level of the liquid contained in the aforesaid jar or vessel.

5551. "Armatures for magneto-electric, &c., machines, &c." J. H. JOHNSON. (A communication from abroad by William Woodnutt Griscom, of Philadelphia.) Dated December 19. 6d. Has especial reference to armatures of the type known as Siemens' armatures, but it is applicable to the poles of all other magnets or armatures, and it consists in dividing the bi-polar extremities of such armatures into two or more sections concentric with each other, one or more of such sections being at such a distance as to utilise the magnetic lines of force which fill the space between the two poles of the field-magnets whilst the other section or sections are arranged so as to pass in close proximity to the poles of the field-magnets and thus utilise the powerful attraction between the poles of the armature and magnet as the one approaches the other. Figs. 1 and 2 represent a transverse section of a magneto-electric dynamo or electro-magnetic armature and a field-magnet respectively constructed according to the said invention. Referring to fig. 1, A is an armature of the

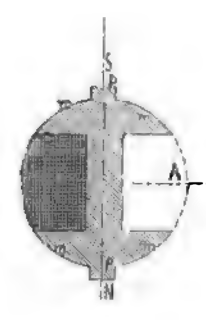


FIG. 1.

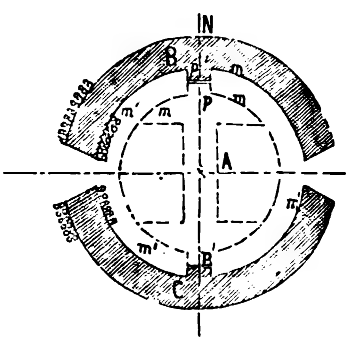


FIG. 2.

before-mentioned type having its bi-polar extremities divided into two or more sections concentric with each other, one or more of such section, *m*, revolving or working at such a distance within the field-magnets, B and C (*see* fig. 2), so as to utilise the magnetic lines of force which are generated and disseminated in the magnetic field or space between the two poles of the aforesaid magnets. The other section or sections, *p*, before referred to, are longitudinal ribs or projections concentric with, but extending or protruding above or beyond, the peripheries of the other sections, *m*, so as to pass when the armature is revolving, in closer proximity to the poles of the field-magnets, B and C, than do the said sections, *m*, so as to economically utilise the lines of magnetic force between the poles of the field-magnet. The interior surfaces of the field-magnets, B and C, are formed or provided with projecting ribs or pieces, p^1, arranged so as just to clear the projections, *p*, upon the armature, A, when it is revolving. In this manner the poles, p p^1, are caused to utilise certain magneto- or electro-inductive influences upon the extremely close approach of iron to iron, while the polar surfaces, m m^1, are arranged for utilising the induced lines of force extending across the magnetic field of the magnets, B and C.

5566. "Producing electric currents." ADAM MILLAR. Dated December 20. 2d. Relates to improvements in apparatus for producing electric currents, and consists in arrangements for utilising the inductive action which a magnet has upon a conductor forming part of a closed circuit and placed in one part of the magnetic field of the magnet, whenever the magnetism of the magnet is made to vary in intensity by the action in another part of the magnetic field of an armature or another magnet, or of a conductor carrying a current, or of any other body which increases or diminishes the magnetism of the magnet. (*Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent.*)

5573. "Telephones and telegraphs." W. R. LAKE. (A communication from abroad by J. H. Rogers, of America.) Dated December 20. 8d. Relates to a method of secret telephony, or telegraphy, in which two or more circuits are used in such a manner that any one tapping but one of the circuits is unable to obtain anything but a confused and unintelligible series of signals. The said invention also relates to apparatus employed in carrying this method into effect. The said invention is partly based upon the use of an interrupted current as distinguished from a pulsatory current. According to this invention the inventor passes a message sent from any transmitting instrument through two or more circuits alternately in rapid succession. A receiver is placed in each circuit so that the two receivers together give a continuous series of signals, the one supplying what the other omits. The current conveying the message is thrown alternately on each circuit by means of a circuit-breaker which makes and breaks contact with each circuit in succession.

5593. "Dynamo-electric machines." L. S. POWELL. (A communication from abroad by Jean Marie Anatole Gérard Lescuyer

Paris.) Dated December 21. 6d. Relates to dynamo-electric machines and it consists in certain improvements in their construction and arrangement. In carrying out this invention, the improved dynamo-electric machine is constructed with a movable inducing part formed by a wheel, say, for example, of brass or gun metal, which is keyed upon a shaft mounted in suitable bearings. A certain number of straight electro-magnets are arranged on the circumference of this wheel in such a manner as to present alternate north and south poles on each side of the wheel. These electro-magnets are connected with a collector on the shaft of the machine communicating through rubbers or brushes with a machine generating direct or continuous currents. The induced part is fixed or stationary, and consists of two series of oval or elliptical coils attached to two rings or frames of iron or copper placed on each side of the inductor. The wire in these coils is wound between two elliptical plates or cheeks connected together by two iron connecting bars and a copper bolt which serves to attach the coils to the rings. The connecting bars nearest to the centre of the machine are preferably angular in cross section and the bars nearest to the outer extremity of the cheeks are preferably circular in section and somewhat thicker than the angular bars. The wire is wound upon these bars in the space between the cheeks. The cheeks facing the inductors or revolving magnets are perforated with a number of holes; but the cheeks which face the rings or frame are imperforated. A thin sheet of metal is interposed between each layer of wire in the coils in order to assist the inducing action and prevent the formation of extra currents. The currents generated in the coils by the passage of the inducting electro-magnets are alternate and may be used separately or may be combined by means of a commutator.

5595. "Electric calls for telephones, &c." A. W. LAKE. (A communication from abroad by W. C. Lockwood, of Brooklyn, America.) Dated December 21. 6d. Relates to telephone calls. In this invention the operating call winds up a spring mechanism.

5599. "Insulated conductors for telegraphic uses, &c." WILLOUGHBY SMITH. Dated December 21. 2d. Has for its object improvements in insulated conductors for telegraphic and other uses. The insulated conductors now used in submarine, subterranean, and other telegraphs consist for the most part of copper wire covered with gutta-percha, and the gutta-percha is used in as pure a state as it can be obtained. Now for this pure material, which is expensive, the inventor substitutes a compound of gutta percha with zinc white.

5604. "Galvanic batteries for electric lighting, &c." E. B. BURR and W. T. SCOTT. Dated December 22. 6d. Has for its object improvements in galvanic batteries for electric lighting and for other purposes. The improved galvanic battery consists of zinc and carbon elements arranged in cells made of wood lined with waterproof cement. The cells are filled around the elements with asbestos fibre, blown slag, or like material, and this is saturated with a mixture of bichromate of potash and phosphoric acid with a little nitric acid added.

5615. "Cables for telephonic and telegraphic communication." J. N. CULBERTSON and J. W. BROWN. Dated December 22. 6d. Has for its object improvements in the construction of cables or collections of metallic conductors for telephonic and telegraphic communication. According to the present invention the inventors employ pipes made in convenient lengths and with perforated insulating discs at each end. The wires in similar lengths are threaded through these discs and such other intermediate insulating discs as it may be convenient to employ and are strained tight.

5623. "Measuring electric currents." C. A. CARUS-WILSON. Dated December 23. 4d. Relates to means or apparatus for measuring electric currents, and it consists essentially in the employment for this purpose of a secondary battery or secondary batteries which, or each of which, is first charged or acted upon by the current to be measured or a part of it, and is then allowed to discharge or run down or has its current reversed, these alternate actions being repeated and made to communicate motion to or regulate the action of any given counting or integrating apparatus. (*Provisional only.*)

5627. "Electric call signals." H. J. HADDAN. (A communication from abroad by G. W. Foster and F. B. Wilson, both of Paris). Dated December 23. 2d. The improvements consist of clockwork provided with an escapement in combination with a double helix, furnished with a metallic rod, having an armature on one end, said armature being placed directly in front of the helix for the purpose of being attracted towards said helix by passing a current of electricity through the same. The slightest movement of the armature caused by the current being broken releases the escapement and allows the main spring in the clock-work to run down or unwind and in so unwinding causes a hammer connected with the said clock-work to strike a metal gong and give forth a series of taps or a single tap on the gong to attract the attention of any one in the immediate neighbourhood of the instrument. (*Provisional only.*)

5631. "Secondary batteries." J. S. SELLON. Dated December 23. 2d. Relates to the construction of the terminal plates, supports, retainers or frames upon and in which the active material or agent is deposited, placed, or fixed. In carrying out this invention the inventor constructs such plates, supports, retainers, or frames of a material or materials not readily subjected to the destructive influence of oxidation or other destructive action, such, for example, as carbon either in a solid form or compressed or mixed or amalgamated with other substances or as asbestos, wood, papier mâché, cellulose, either alone or in combination with metals not easily oxidised, such, for example, as platinum. The plates, supports, retainers, or frames, composed of one or more of these materials, are constructed in the following or other suitable form or forms. For example, they may be made of a cellular, perforated, corrugated, grooved, fluted, roughened, indented, tubular, or woven shape, or any combination of these forms or of any other shape capable of retaining the active material or agent in a finely divided, pasted, deposited, compressed, or other condition.

CITY NOTES.

OLD BROAD STREET.

THE METROPOLITAN (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

LAST Monday, at noon, an extraordinary general meeting of the members of this company was held at Cannon Street Hotel, Sir Michael Kennedy, R.E., K.C.S.I., presiding, for the purpose of considering, and, if thought advisable, of passing, as a special resolution the following resolution, or a resolution or resolutions to the following effect, that is to say—

"Resolved—That the Articles of Association of the company be, and the same are hereby altered as follows :—

"(I.) By the insertion in Article 4 after the words 'the directors may,' with which it begins, of the words 'with the sanction of a general meeting.'

"(II.) By the alteration in Articles 81 and 89 of '1886,' therein mentioned, to '1884.'

"(III.) By the omission of Articles 85 and 100."

The secretary (Mr. Robt. Wilson) having read the notice convening the meeting,

The Chairman said: We are assembled here to-day for the special purpose of considering, and, if you think advisable, to pass resolutions making alteration in certain of our Articles of Association. These alterations have been dictated to us by the Committee of the Stock Exchange, who, unless we make the necessary alterations, will not grant us a quotation. And it is very desirable that we should have as little delay as possible before getting a quotation, and the only difficulty which now lies in our way is that which we have met here to-day to overcome. A very few words from me are requisite to make you acquainted with the nature and the scope of the desired alterations. The first is in clause 4 of the Articles, and its object is to prevent the directors, without the sanction of a general meeting, issuing shares at a discount. The alterations in Articles 81 and 89 are merely to reduce the time in which the present board holds office from "1886" to "1884." The next alteration is the omission altogether of clause 85 of the Articles, and the object of that is to secure that all matters of importance which may require the consideration of a general meeting should be discussed in a general meeting, and not be settled by correspondence; the arrangement in the expunging of Article 100 is somewhat similar—to enable matters to be settled by the board and not settled by correspondence. I trust the resolutions to be submitted will commend themselves to you generally. I therefore beg to move the following resolution :—"(1), Resolved that the following words be inserted at the end of Article 4, 'provided always that no shares shall be issued at a discount without the sanction of a general meeting;' (2), that, in lieu of '1886,' occurring in Articles 81 and 89, respectively, '1884' be inserted; (3), that Articles 85 and 100 be, and hereby are expunged."

Mr. Whitehead in seconding the motion, said it was not necessary for him to detain the meeting with any lengthened observations. It would be clear, he thought, to the shareholders present, that the suggestions made to them by the Committee of the Stock Exchange were in themselves very reasonable. They did not interfere adversely with the value of their property, and they would obtain for them an early settlement and quotation, while immediately enhancing the value of their shares in the market. He was sure the resolution would commend itself.

Mr. Wright asked that the chairman would read Articles 85 and 100 as they now stood; and might he ask also if the board could inform the meeting why it was that the shares which were at a premium in May last of 18s. and 15s., were now at 25s. and 30s. discount.

The Chairman having read the articles referred to, said that, as regarded the price of the shares, he was not able to answer that question. He supposed that the reason why their shares did not stand at the premium they formerly did was because they were purchased by speculators.

Mr. Wright said perhaps he put the question rather vaguely. He thought that perhaps the board had some knowledge or some reason amongst themselves in connection with the character of the work being carried on.

The Chairman: I can emphatically deny that the board have any knowledge of the reason why our shares stand at the present rate.

Mr. A. H. Rolls remarked that the shareholders were a little foggy as to what the operations of the company were, and if the chairman could enlighten them he should be glad.

The Chairman remarked that they had met there that day to discuss a special, and come to a special, resolution. However, he had no hesitation in saying that the prospects of the company were very favourable. They were receiving large numbers of orders, were establishing central stations in different parts of the metropolis, and they expected to do a very good business. This was hardly a meeting in which to discuss the question asked. They believed in the "survival of the fittest," they had a good system and a large field. With the assistance of Mr. Hammond, who sat near him, they were pushing the business, and pushing it with very good success. He could not answer every question particularly, but answering generally he must say that their prospects at the present moment were quite as favourable as they could expect them to be under the circumstances. They had not long commenced, and there had been many a difficulty before them. There was a difficulty as regarded legislation, and there was a difficulty with regard to an accumulator. They had been taking steps for overcoming their difficulties, and when they had had a little more time they would be doing a very good business.

Mr. Bischoff read Article 4, and asked if it were not true that all the shares were not already allotted.

The Chairman replied that the whole of the shares were applied for several times over. The whole were allotted. There are, however, a few still unallotted, because certain gentlemen withdrew.

Mr. Bischoff asked if this alteration in Article 4 was merely to conform with the requirements of the Committee of the Stock Exchange?

The Chairman: Entirely.

In reply to a shareholder, the Chairman stated that the number of shares unallotted at the present time was 310.

In reply to Mr. Thomson, the Chairman said that no shares were allowed to be withdrawn after the allotment except in those cases in which the persons were legally entitled to do so.

The resolutions as previously moved and seconded were then put to the meeting and carried unanimously.

The Chairman: We have now disposed of the special business we met to transact to-day, and our first statutory meeting will be held to confirm those resolutions now passed at the earliest possible moment. That will be within one month from the present. A statutory meeting was to be held within four months of the time of registration.

Dr. Pocock said he would like to call attention to one specially valuable feature of the electric light, which he thought might be advantageously dwelt upon in their prospectus, namely, its use in sick chambers, and so on, where it was of particular importance to have a light that would not vitiate the atmosphere. He had a good deal to do with that as a medical man. It frequently happened that a considerable quantity of gas used in lighting passed away unconsumed. In that respect, as well as in its keeping the air of the chamber cool, he had found the electric light far superior to any other source of illumination with which he was acquainted.

Mr. Hammond said that that special feature of the light was referred to in the prospectus, as it was undoubtedly a great advantage.

The proceedings then terminated.

THE ELECTRIC LIGHTING AND MAINTENANCE COMPANY (LIMITED).

ON Monday afternoon last a numerously attended statutory general meeting of the above company was held in the City Terminus Hotel, Colonel R. R. Jackson presiding in the absence of the chairman of the company, the directors present being Messrs. Sandeman, Pixley, Norman, Lee, Maudslay, and Young.

The secretary, Mr. F. R. Grigg, having read the notice convening the meeting,

The Chairman said: Gentlemen, I very much regret that Mr. Martin Smith, chairman of the company, owing to a very serious domestic bereavement is unable to attend the meeting to-day. The directors regret it the more because Mr. Smith has a very large pecuniary interest in the company, pays great attention to its policy, and has very strong views as to the lines upon which we ought to work. I regret also that the vice-chairman is absent because he is in America. You are aware that this is a statutory meeting of the company—a meeting called under the requirements of the law—and that there is usually no business whatever transacted at a meeting of this character. The directors of course must adhere to that line as regards the transaction of business, but they feel it their duty to explain the course they have pursued hitherto, and the policy they advocate in the future to the shareholders who are present to-day. The directors have not found it expedient to sink the money intrusted to them so far in the erection of electric installations. They have found that there has been a very great change in the position of the electrical world since they issued their prospectus: there has been an enormous number of new companies created, and the manufacturing companies which at that time held the greatest prominence have adopted the policy of the formation of sub-companies. The result is that instead of there being only about half a million at the disposal of electric light companies, as there was when the prospectus was issued, there are about twelve millions of capital at their command supposing the shareholders respond to the calls that may, in the discretion of their directors, be made upon them. One result of this change in the position of affairs has been that there is a very much larger number of companies prepared to erect apparatus in order to give the public the use of the electric light, whilst the manufacturing power is very little increased. Electrical apparatus, therefore, is excessively dear, and its dearness interferes with profitable investment for the purpose of electric illumination. Your directors have, therefore, thought that it would be wiser for the time being to look on and to see whether in process of time electrical apparatus will fall in cost so far as to enable this company to buy on advantageous terms. If not, then the directors of the company would possibly recommend to the shareholders the adoption of the policy foreshadowed in one of the later paragraphs of the prospectus, departing to a certain extent from the line indicated generally as the policy of the company, and to start manufacturing. In certain eventualities that in all probability would be the right policy for the company to adopt. I am happy to be able to inform you that the capital of the company is practically intact. 20,034 shares were allotted, and no portion of the money subscribed has been returned, and making provision for the staff of the company for some time to come, and the rent of its offices and all the expenses incurred, a very small amount per share would meet all the liabilities and expenditure so far as yet incurred by the company. The delay of the company in erecting installations has resulted to a certain extent also from a desire to see what the clauses of the Electric Lighting Bill would be. Now there is one of these clauses which it strikes the directors of this company is calculated very much to retard the progress of the electric light, and to cause it to cost a great deal more than it ought to the general public—I mean that clause which enables public bodies to take over the property of electric companies at the expiration of fifteen years, without giving anything for goodwill, and simply taking the then value of the plant. That seems to me a very absurd provision, because invention as regards the electric lighting is in its infancy. It is very probable that the first apparatus put down may have to be renewed more than once in the course of fifteen years, and if the electric light companies are to charge the public for the use of the light in proportion to the risks run and the expense incurred, the charges must be so great as to prevent the use of the electric light by the general public. The Bill, therefore, seems to be a Bill in its present form which is better calculated to protect the gas companies than aid the development of the new light. I do not think, however, a clause so unjust as that can continue to remain long in the Bill, and I think when the nature of its operations is fully understood by parliament we may reasonably expect that it may be materially altered in the direction of fair play. With reference to the position of the capital of the company, if any questions are asked hereafter, I shall be prepared to answer them with the utmost care, it being the desire of the directors that there should be nothing whatever under any circumstances withheld from the shareholders. To complete what I think it necessary to say to you now, I beg to state that the directors have not taken, and will not take any remuneration whatever for their services until the shareholders receive a dividend (hear, hear). You are aware, I think, because the terms of the prospectus explain that fact, that the preliminary expenditure has been met by the directors—they doing that in consideration of having allotted to them certain founders' shares, which will only be of value after the shareholders receive 6 per cent. (hear, hear). One other subject I may mention before we listen to the remarks of shareholders: there will be no call made in September.

Mr. Geo. Whitley said that the first issue was quoted at one million sterling, and, as an addition, there were £3,000 of what they called founders' shares. Only £200,000 was subscribed. He would like to ask if they thought it quite fair that these £3,000 should be charged to the small fraction of what was originally intended to be £1,000,000.

The Chairman said that he thought the answer to Mr. Whitley's question a very simple one. On the present subscription of £200,000, the profit on the founders' shares was one-third of the profit which would remain after the payment of 6 per cent. If there was no business done there would be nothing to receive, and therefore these shares would be no burden upon the issue. They were issued as fully paid up, and there would be no interest to them in the business of the company until the shareholders received 6 per cent.

Mr. Porter said that the directors wished apparently to give them a clear statement of the position of the company, and the chairman had certainly done so. When the prospectus was originally issued it was supposed that it was proposed to call one million up, and keep it profitably employed. That was at the commencement of the Easter holidays, but the lists were suddenly closed when only £200,000 was collected, and in a circular issued on the 8th April it was stated that the reason of closing the lists was that it was desirable to commence operations at once. They now learned, however, that that was not the case, that nothing had been done within the past three months, that on the contrary the prospect of getting work was very much worse now than it was at that time, because those parent companies, if they might so call them, had given monopolies to subsidiary companies, and therefore an independent company like their own had no apparent prospect of profitable work left. He therefore thought that the question at the present time—though he was merely expressing his own private opinion, having had no conversation on the matter with other shareholders—was whether under the circumstances he had mentioned it was desirable to keep the company going. Whether it would not be better to wind up the company at once. He did not say that in any hostile spirit to the directors. They had done their best, and had the capital still intact, and it had been also stated that they did not wish to receive any remuneration until the company had received a dividend. Nothing could be more fair and straightforward (hear, hear); but still he thought it was still a question whether the reasons he had given did not make it desirable to close the company.

Mr. W. H. Maturin was a little disappointed at the position held by the company and at their not being able to carry out their plans, but he was not surprised at it, the prospect had been so very uncertain, the policy the directors had shadowed out was a very judicious and prudent one, to keep the capital safe in their hands, and not to use it till they could do so advantageously, and only then, as far as they could, with the knowledge and consent of the shareholders. That was a very satisfactory thing for them to consider, and there was another satisfactory thing that the gentlemen connected with the company did not intend to draw any remuneration until the company was a paying concern. He was also glad that they had kept the expenses down to a minimum.

The Chairman said he might add that in regard to the expenses what he wished to convey was that a very small amount per share would meet the expenses already incurred, not that it was their intention to make a call for that purpose.

Mr. Maturin would like to know what amount of money was paid up.

The Chairman said that the amount was £39,918.

Mr. Maturin said he supposed that they were then deriving an income from the investment of that sum. That though it was possible their expectations might not be realised, and that the company might have to wind up, his opinion was that that time had not arrived yet. They did not know what might occur a few months hence, and there might be opportunities to make their company a paying concern. He thought the directors were bound not to incur any expenses whatever beyond what might be paid out of the interest of the money they had, which, doubtless, if advantageously invested, would yield 3½ to 4 per cent. That being the case, and the shareholders knowing that they were incurring no further liabilities, and that their money was perfectly safe in the hands of the directors, they should simply hold it in trust

to see whether a good time would come for employing it. He believed that it was better not to speak of winding up the company, but to leave that to the directors to bring before them at some future time.

Mr. W. Thomson asked if it was a fact that money was returned to any subscribers to shares, on allotment, or at any other time, and if so why was it so returned?

The Chairman said that the simple answer to that was that no money had been returned.

Dr. W. Pocock said that a waiting policy in an affair of this kind which required to be developed and which in the meantime was more or less arrested in its development, showed that the directors had been actuated by a very satisfactory judgment of the position of the company, and he believed the policy was one which recommended itself to all thinking men. The fact of the company not having called up a large amount of capital was an evidence of some doubt in the minds of the board as to the advisability of the course entered upon. They should bear in mind that they were crippled at the outset by legislative proceedings, which had been referred to, which, however, would scarcely stand the light of a very long period without being reversed or at least altered. He believed the policy adopted was the resultant of a very great deal of quiet thought and careful judgment on the part of the directors in the exercise of their functions. They should trust them for the future, and give them support in the careful policy which they had initiated.

Mr. Richard Wilson said that when the company was started a prospectus was issued which invited subscriptions to the amount of £1,000,000, and a statement was subsequently issued that only one-fifth of that had been subscribed. Under ordinary circumstances, when a large sum was invited to be subscribed by the public and it was found that only a small subscription was made, the directors did not usually proceed to the allotment of the shares; and he confessed that when he received the paper stating that the shares had been allotted, he was very much surprised at that departure from the ordinary proceeding in such cases. He quite agreed that it would be better to return the capital.

The Chairman said that the directors would be largely guided by what they found to be the general wish of the body of the shareholders.

Mr. Whitley said that in the original prospectus the objects of the company were put in the forefront as electric lighting and maintenance, and it was a question with him how far they were justified in leaving these and embarking in manufacturing, which was only found at the tail of the articles of association. The main conditions of these articles were now proposed to be left out, and they were going to manufacture and trade on the strength of a little article at the very end of the memoranda of association. He did not think that was fair. The main objects of the company were to have the electric light laid on wherever it was required, and if that failed the object of the company failed to, and it would be far better to wind it up and start a new company for manufacturing.

The Chairman: Gentlemen, I think the shareholders have been extremely fair in the expression of their opinion upon the subject which has been before the meeting. Mr. Porter's remarks were very much to the point. It might be thought, if there was no immediate means of finding profitable employment for the money of the company it would be wiser to return it. It was however thought, as was expressed by Mr. Maturin, that it was better to wait and watch the progress of events for awhile, and see if the policy upon which the company originally was formed was not the right policy, and if circumstances did not so turn round as to enable the directors to employ your capital profitably. The directors' view is entirely in accordance with that of the second speaker. His expression of opinion was remarkably fair, and there was only one point in it upon which I wish to make any comment in an opposite direction. He said that the directors should limit their expenditure to the interest to be derived from the money in their hands, as nearly as possible. That ought to be so, but it is not quite possible, because it is necessary for us to have a staff, to have a certain number of trained men who are constantly looking out and observing what is going on in the electrical world and reporting it to the directors; and then there is the rent of the premises we occupy now. These expenses will come to somewhat more than the interest of the capital in our hands. The amount that the shareholders are already responsible for covers the salary of the engineer for a year, other salaries for six months, the rent of the premises for a whole year, and if we wait for some time—say, six months—very little additional expenditure will be incurred; so that I for my own part and the directors as a whole, favour the waiting policy. One reason why we did not at once invest your money, as we intended to do, was, that although we were offered a great number of installations, and might have invested a great deal of money, when we came to examine the probable result, we did not feel justified in accepting them because there was no adequate profit. That was a disappointment to the directors, but they explained the fact to themselves, as it has been explained to you to-day, and they think there is likely to be a change in the circumstances which will enable them to give the public the benefit of the electric light with advantage to the company and to the shareholders. If it proves not to be so, whatever your resolution to-day, the directors will certainly not risk your money, and would prefer winding up the company. Mr. Whitley, I think, made some observations as to the fact that we asked for a million, and having received £200,000, we still went on with the company. Now I do not see how our receiving applications for £200,000 instead of a million altered our position at all. If our policy was right we could carry it out with £200,000 almost as well as with a million, and if it was wrong then it was better not to have locked up a larger sum of money. So I don't see that the directors were bound when the subscriptions amounted to only one-fifth of what was asked to return the allotment and refuse to proceed with the business of the company. I don't know that any other remarks were made which might require any comments from the chair. The directors are of course gratified by the expressions of confidence in them, to which Mr. Maturin, Dr. Pocock, and others have given expression, and it will be their endeavour under all circumstances to retain the confidence of the shareholders by acting in accordance with their interests. This being a statutory meeting, it is impossible to pass a resolution, but the directors would like to make use of this opportunity which they have of meeting the shareholders to ascertain their opinion in an informal manner upon one or two points. I will ask those who think the policy of winding up the company is preferable to the policy of waiting, to hold up their hands. [Nine hands were held up.] Nine. Those who prefer a waiting policy, which the directors favour, will please hold up theirs. [A great number of hands were held up.] There is a very large majority in favour of waiting. You must recollect that what we are doing is quite informal.

Mr. Whitley asked whether they had any contracts on hand.

The Chairman said they had not.

Mr. Whitley said that if they adopted a waiting policy would they not then be committed to a lot of contracts before their next meeting?

The Chairman said he must ask for the confidence of the shareholders (hear, hear). He would hardly venture to answer that question, because if they were offered installations that would pay they certainly should invest the money of the company in them.

Mr. Porter said that while they were very much indebted for the courteous manner in which the chairman had replied to their queries, he was sorry that the question had been put so hurriedly. He was going to propose a kind of compromise. He thought they were all satisfied to leave their interests in the hands of the board, but it appeared quite clear that the directors admitted being disappointed in the anticipation of obtaining profitable work, but that also it was well to adopt a waiting policy in view of certain circumstances that might arise. The expenses for the next six months would not be so proportionately heavy as they had been in the past, and it was better to hold their hands and see how things turned up. He would, however, suggest that if in the course of three or four months they were still disappointed in their anticipations of obtaining profitable work, a meeting should be called and the question submitted to the shareholders whether under these circumstances they should go on any longer or not (hear, hear).

The Chairman: There is one question with reference to which we should like to have the informal opinion of the shareholders. I explained to you that the directors thought if electrical apparatus could not be got at a moderate percentage on the cost—if they still continued so high—it might be a wise policy on the part of the company to manufacture their own apparatus. I should like to know what the opinion of the shareholders present is upon that subject, and I would ask those who think that under such circumstances it would be desirable to manufacture such apparatus to hold up their hands.

Mr. Porter: Please don't put that. I do not think this meeting ought to deal with that. I think we should leave that in your hands whether you find it profitable or not. We should leave that entirely to the responsibility of the board (hear, hear).

The Chairman: If that is the opinion of the shareholders of course the directors will take upon themselves the responsibility of acting to the best of their judgment, and giving account to the shareholders at the earliest possible moment afterwards. Still, as we have gone out of the region of strict formality, I thought there might be advantage in arriving at your views on that very important subject. I am glad that you have decided that it is the general view of the shareholders present that it is best to leave that subject in the hands of the directors.

Dr. Pocock said that after the clear and satisfactory statement of the chairman there could not be the slightest hesitation in saying that the board was actuated by feelings which would prompt them to consider the shareholders' interests. He thought they decidedly ought to leave the management of their capital in the hands of the directors to use in the best possible way.

The Chairman: Now, gentlemen, we may consider, if you will, the statutory meeting over, and we will become an extraordinary general meeting, for the purpose of considering and, if thought fit, of passing the following resolution: "That the regulations of the company be altered so as to authorise the company so far to modify the conditions contained in its memorandum of association, as by subdivision of its existing shares, to divide its capital or any part thereof into shares of a smaller amount than £10 each, and that thereupon each of the A shares of £10 each comprised in the capital of the company, stated in the memorandum of association, be divided into two A shares of £5 each; and each of the B shares of £10 each, comprised in the said capital, be divided into two B shares of £5 each." That was a suggestion made to us during the progress of the formation of the company, and it was suggested there would be some advantage in having a £5 rather than a £10 share. I must, however, inform you that that change cannot be made without more or less expense, and I do not see any adequate object to be gained by it under existing circumstances. However, it is within the province of this meeting to propose a resolution on the subject, and I shall be prepared to receive a resolution and submit it to the meeting.

Mr. Maturin asked if it was to be understood that the directors did not recommend the subdivision?

The Chairman said that the directors thought that it was not sufficiently important to justify them in advising the shareholders to make the change.

Mr. George Whitley moved that the regulations of the company be *not* altered.

Captain S. A. E. Barrow seconded the motion.

The Chairman put the motion to the meeting, and it was carried unanimously.

On the motion of Mr. Porter a vote of thanks to the chairman was passed by acclamation, and the proceedings terminated.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS (COMPANY) LIMITED.

THE half-yearly general meeting of the above company was held in the Cannon Street Hotel, on the 25th inst., Mr. George Henderson, chairman of the company, in the chair. The secretary, Mr. W. J. Tyler, having read the notice convening the meeting,

The Chairman said: Gentlemen, we do not, as you know, issue any report or statement of accounts for this meeting. I dare say you will be glad to have some information as to what we have been doing for the past six months. I am glad to say that in most departments of our business we have been fairly well employed, and can report an increase of sales, apart from cables, of about £33,000 over the first half of 1881. The market price of our staple material—india-rubber—has considerably advanced, and to meet this, as far as possible, we have raised our selling prices, though not sufficiently to cover the advance. We are doing a good business with our own Government in the departments of the Admiralty, War Office, and Post-office, and have obtained a share of the business arising out of the increased use of electricity. As to cable construction for the half-year, we have executed a second contract with the Mexican Telegraph Company, having manufactured and laid for them a cable of about 275 miles, as an extension of their system in the Gulf of Mexico. This gave employment to our steamer *International*, which after completing that work was engaged to repair one of the International Ocean Telegraph Company's cables between Florida and Cuba. Early in the year we supplied the West India and Panama Telegraph Company with 300 miles of cable, and in May the French Government with 140 miles for the coast of Tunis. The French Government continues to employ us both here and in France. At Persan we are making a considerable quantity of underground cable for it; and at Silvertown we have in hand a second Tunis cable of 260 miles, the laying of which in the autumn will give further employment to our steamer the *International*. The chief work of the year, the Central and South American Cable expedition, has proceeded very satisfactorily. The *Dacia* has returned, having accomplished her share of the work, and the *Silvertown*, according to the latest telegrams from our engineer, Mr. Robert Kaye Gray, is engaged in laying the last section. He expects to have the whole system completed from Vera Cruz to Callao, amounting to over 3,000 miles of cable, by the end of the present month. Happily the expedition has been conducted hitherto without important accident or serious illness, and all our staff have worked cheerfully and energetically in spite of long hours and much exposure in a trying climate. We hope to meet you again in February with a good account of the year. To-day you are called together chiefly to sanction the payment of the usual *ad interim* dividend of 5 per cent. Before concluding, however, I ought to mention that on the dissolution of this meeting an extraordinary general meeting will be held for the purpose of electing an auditor to act in conjunction with Mr. Weise, in the room of Mr. James Cowan, deceased. I have merely now to move that the *ad interim* dividend of 5 per cent., or 10s. per share, free of income-tax, payable on the 26th inst., be now declared.

Mr. S. W. Silver seconded the motion, which was put to the meeting and carried unanimously.

The Chairman said he was perfectly certain that their manager, Mr. Gray, and staff would do everything in their power to conduct the business satisfactorily.

The extraordinary general meeting was then held for the purpose of electing an auditor in the room of Mr. James Cowan, deceased. The secretary having read the convening notice, Mr. Hanson said that he would be very happy to propose for the vacant auditorship a gentleman who he thought would do good suit and service to the company if elected, though he was not offering himself as a candidate. He was a large shareholder, of very good commercial experience, and in early life was accountant in a Joint Stock Bank, so that he ought to know something of accounts. He is now a director of the National Bank of Australasia. He held 216 shares, and therefore had a considerable interest in the status of the company. He begged to move that Mr. Abraham Scott, of 4, Palace Road, Streatham Hill, be elected auditor for the current year in the room of Mr. Cowan, with a remuneration of 30 guineas.

Mr. Randall had great pleasure in seconding the nomination. He regretted very much the loss of the gentleman whose place Mr. Scott was nominated to take.

The Chairman put the motion to the meeting, and it was carried unanimously.

Mr. Scott briefly expressed his thanks for the honour they had done him in electing him to the vacant post; he only hoped he would be able to serve them as well as the gentleman whose loss they so greatly regretted.

Mr. Hanson said that before they separated they owed it as a duty to their directors, to offer them their best thanks for the success that had resulted from their management of the company's affairs. He thought the best proof they could have as to the stability of their position was that very little fluctuation in the value of their property ever took place; whether there was war in Egypt or anywhere else, their property remained very much the same. He begged to move a vote of thanks for the directors.

Mr. Treble seconded the motion, which was passed by acclamation.

The Chairman briefly responded, and the proceedings then terminated.

THE EUROPEAN, AMERICAN, CANADIAN, AND ASIATIC CABLE COMPANY.

THE prospectus of this company has been issued, and according to it we learn that it "proposes to establish international telegraphy upon a system of mutual profits, and to work at a much lower word-rate than the existing cable companies offer to the public.

"The Act authorises the establishment of telegraphic communication between Sable Island and any other point or points on the shores of the Dominion of Canada that the company may select, and such point or points on the coasts of Great Britain, Ireland, and the Continent of Europe or elsewhere, as the company may determine, and from any point or points on the Pacific coast of the Dominion of Canada to Japan and the Continent of Asia.

"The company has also power, with the consent of the Governor in Council, to connect the cables which are contemplated by the Act with the Government internal telegraphic system of the Dominion or with the lines of any telegraph company in Canada.

"The company starts with a threefold advantage. Firstly, it is free from the dead weight of unproductive capital which has been created in the case of other companies to the extent of some millions sterling, owing to several of their Atlantic cables having been abandoned, or rendered unserviceable; secondly, it has all the advantages of experience acquired in construction and laying by former companies; and, thirdly, instead of starting with over-costly and short-lived cables, it has entered into a contract with the well-known Henley's Telegraph Works Company, Limited, for laying down about 6,120 miles of cables, comprising two complete cables between England and Sable Island, and connections with Canada and the United States, at an agreed price of £1,443,176.

"This contract will place the company in a very favourable position as compared with existing cable companies, as is shown by the following facts:—

"The Anglo-American Telegraph Company, Limited, with a capital of £7,000,000, has three cables in working order, and it is said a fourth has been recovered and repaired; the Direct United States Cable Company, Limited, with a capital of £1,300,000, has only one cable; the French Atlantic Cable Company, with a capital of £1,700,000, has only one cable; thus showing five cables representing a capital of £10,000,000. It will further be noticed that this company will have two separate cables across the Atlantic, thereby rendering it independent of external aid, a feature of such self-evident importance that it is not necessary to dwell upon it any further.

"The life of such cables as it is proposed to lay may be safely taken at not less than 20 years, and provision for complete renewal at the end of that time should be ample.

"The company has therefore decided upon carrying on business at uniform low rates, instead of pursuing the vacillating policy hitherto in vogue of tentative reductions, with alternating augmentations.

"A tariff of 9d. per word between England and New York and Eastern Canada will be adopted, which, if necessary or advisable, can be reduced to even a lower figure. (The present rate of the combined companies is 2s. per word.)"

"Experience has shown that the existing companies are unable to work profitably at a tariff of 1s. per word. This company will, therefore, doubtless obtain as much of the traffic as its cables will be able to carry.

"It is computed that the entire working capacity of the proposed cables is equal to the transmission of about 14,000,000 paying words, during 300 full working days, but taking 10,000,000 words as a reasonable average, and allowing £80,000 for working and other expenses, according to careful estimates, the net returns would read as follows:—Gross revenue, 10,000,000 words at 9d., £375,000; less renewal fund, £45,000, and working expenses, £80,000, £125,000; leaving a net profit of £250,000, or equal to about 17 per cent. on the company's capital."

Since the prospectus appeared a letter has been addressed to the editors of the various newspapers by Mr. Weaver, of the Anglo-American Telegraph Company, and on the following day a reply was sent by Mr. S. Leith Tomkins, the secretary of the new company. They are very interesting, but as we hope to deal with the whole subject fully in an early issue, we do not intend publishing them, but shall refer to the leading parts of them when reviewing the subject in detail.

THE GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED.)

THE ninth ordinary general meeting of the above company was held on Thursday the 27th inst., in the City Terminus Hotel, Cannon Street, Mr. John Pender, M.P., chairman of the company, presiding.

The Secretary, Mr. William Payton, having read the notice convening the meeting, and also the minutes of last meeting, the latter were approved and signed.

The Chairman said: Gentlemen, I presume you will take the report as read (agreed). Before I make any remarks generally upon the present state of telegraphy, I will preface them by referring to a little of the detail which has been carrried on during the last twelve months. I want first to call attention to the fact that we have not been inactive during the past year, and have been enabled to make some tangible exchanges, which it is believed will be for the benefit of the company. The proprietors should remember that these exchanges are made mainly in the interests of the shareholders. The wider the basis of our operations, the more we can exchange on proper terms so as to extend the range of our securities, and the greater interest ordinary shareholders obtain. We have had a very large holding in the German Union Telegraph and Trust Company—£180,000, which company is the agent of the German Union Telegraph Company, Berlin. The company found it necessary, in the interest of the growing traffic and to avert competition, to lay a second cable from Embden to Valencia, so as to secure direct cable communication from the German Telegraph Union to Ireland without passing through the country, as formerly. You are aware that the French had a certain *esprit de corps*; and the Germans, of course, seem to have taken the same idea; and to meet the requirements of the growing traffic, they thought it better to have their own direct line from Germany. That cable has been made and laid, involving a duplication of the capital

of the Berlin company, and they issued 5½ per cent. preference shares. Your directors thought it well, having regard to the large holding of ordinary stock represented by the trust shares, to secure not only a rateable number of the 5½ per cent. shares. The directors felt it essential to cover the risk of the German Union by accepting these preference shares, which, no doubt, are of quite good security; for the German Union paid 10 per cent. for the year 1880, and 8¾ per cent. for the year 1881, and the prospects are now better than they have been. The purchase being large, involving something like £140,000, the available cash balance of this company and the trust certificates were applied to this purchase, and we also had to borrow £18,000, which is the extent of our liability in this purchase. We have been enabled to acquire preference shares at a price which will give 5½ or, say, 6 per cent. for our preference and 4½ for our ordinary shares. We have acquired also a parcel of German Union Telegraph cable shares, and have exchanged 500 Indo-European shares for our shares on favourable terms, and also 1,000 Eastern Telegraph shares. The Indo-European and the Eastern we look upon as a very valuable property. We declared, in the year '80 and '81, dividends on the ordinary shares of 4½ per cent., and your board regret to have to show a falling off from this rate of interest. It is a small falling off, but they hope they will very soon recover it. It is attributable to one cause only, that is, the competition in the Atlantic. In the financial year ending July, 1881, we received 3¼ per cent. from the Anglo-American Company, making the sum of £36,400; during the last financial year, ending July, 1882, we only received 2¾ per cent., or £30,800, a difference of £5,600. This is the main reason why the dividend is diminished. The two shilling tariff now in force is bringing in such an amount that I am hopeful that the next dividend of the Anglo-American will be such as to enable us to recover the dividend paid last year. In regard to the expenditure, there is very little difference as to the result of the year, and we give full details of our very modest outlays. When we made exchanges of shares in the ordinary course of business from time to time, we applied to the Committee of the Stock Exchange for an extension of the quotation, so as to embrace the number of shares issued and keep our quotation and issue in perfect order. The number of shareholders is still on the increase, and I presume we may take it as an evidence of the popularity of the security which the company offers, that while last year it reached the large number of 5,800, to-day the number of shareholders is 6,250. Since last I met you here our friend and colleague, the Right Hon. W. N. Massey, has passed away, and in him we have lost a man of very good sound sense. He was associated with the Globe Company from its very commencement, and his death is a loss which we all deeply regret. We have appointed in his place at the board Mr. Henry Daniel Gooch, son of Sir Daniel Gooch, whose name is honourably associated with submarine telegraphy. Mr. Gooch has also had some experience of a telegraph company, and therefore we have in him a younger life and a valuable accession to the board. Mr. Newmarsh, one of our auditors, has also passed away. His reputation was world-wide, and every one who saw his name was satisfied that the work he had to do was accompanied with the highest sense of honour. We have appointed in his place—or, rather, the shareholders at the last meeting were unanimous in appointing—Mr. William Griffith, B.A., Barrister-at-Law. So far as I have had an opportunity of observing, Mr. Griffith has been very careful indeed in seeing that the accounts of the company are in proper order. Now I have to make a few general remarks. In the first place I may refer to the Anglo-American competition in the Atlantic. I daresay you have read in the newspapers the prospectus of the company which was launched last Saturday, and seen the report of the managing director—or rather the criticism of the managing director—of the Anglo Company. That is so complete that I need scarcely add one word. The only thing I may say is that it does astonish me in a great commercial city that such a prospectus should have been seen. It is such that the men who have prepared it, and I am afraid, many of the honourable names associated with it, had not in the slightest degree a knowledge of what it implies. I can only say this, that if the company is floated—which I have considerable doubts about indeed—it would be literally impossible for them to realise what they put forward in their prospectus. A grave responsibility, therefore, rests upon those who have issued this prospectus, a responsibility so great, that I am perfectly satisfied that when many of the names associated with it begin to realise their responsibility, the result will be that there is very little chance of its proceeding beyond the paper in which the proposal has been made. However, that is a thought resting entirely with those gentlemen. Just one point I may mention, as showing how extraordinary the statements are. They assume that notwithstanding the eight cables which we have now in the Atlantic, these eight cables being capable, when in good working order, of doing the work of sixteen cables, this new company assumes in their prospectus and in their calculations that they will do not only all the traffic that the other companies do, but something more than all the traffic that is obtained in the Atlantic at the present I think you will see at a glance that the old companies must be in a very extraordinary state if they stand still and see their business passing away. But as to the cable that they intend to put down, it would be simply impossible for them to do their work. They assume that they will do twenty-five words a minute. Sir James Anderson, who has had great experience of what the best manipulators can do, will tell you that sixteen words a minute is uncommonly good work. Therefore the whole statement throughout is one that, I am sorry to say, shows the greatest ignorance on the part of those who concocted it—and I think it is using a mild phrase to call it ignorance. Probably they would not be able to work their system at more than ten words a minute. Therefore, so far as I can say, and looking carefully into the figures, the chances are, that instead of showing a profit, a loss to such a company would accrue of nearly £50,000. There is another cable which is projected by Mr. Garrett, of the Baltimore and Ohio Company. I am making these remarks, for, as you know, you obtain good dividend from the existing companies, and these might be affected by such new enterprises. His scheme is to utilise, as far as possible, the telegraphs along a very extended and very important system of railway in America—the Baltimore and Ohio Railway. The Baltimore and Ohio Company have not themselves obtained an Act of Parliament at Washington for new lines, but the members connected with the system have obtained this act. My own impression is that the men connected with this company are shrewd men, not likely to get any money in America, if they can get it in England, and are quite justified in getting this addition to their system. But my own impression is that while our telegraph lines generally are at 50 per cent. discount that is not likely to be realised. I think there is a probability that even Mr. Garrett, shrewd man as he is, will reconsider the question before he even induces his friends to go into this large expenditure. I think that now, with a working power which is represented by something like 16 cables in the Atlantic with the duplex system, I think it is possible to provide Mr. Garrett's system with as much cable power as he requires for operations in America, and, therefore, as I have always been a man of peace with regard to submarine telegraphy, I have always thought it better that there should be combination rather than fighting with one another, because in the long run compromises have to be made. I am hopeful that before I have the pleasure of seeing you again we shall have some means whereby we can utilise Mr. Garrett's system by gradually improving our own. The next system that I must refer to is that of the Eastern system of telegraphy and its Eastern Extension. I daresay you are all aware of what is going on in Egypt at the present moment, and probably no company is more prominently before the public engaged in doing good and useful work for the community at large than that company. Had it not been for the arrangements made by the Eastern Telegraph Company we should have been, I believe, without any communication with Egypt to-day. I am sorry to say we have not to thank the Government very much for providing us with anything. We have provided the Government with means for securing a rapid, and perhaps the best, working system of telegraphy between Egypt and Europe at the present. That has been done entirely by forethought, by bringing a ship, at very considerable expense, from the Red Sea to Alexandria, establishing on board that ship our working system, so as to keep the public informed as to all that is going on in these waters; so that every hour in the day when the newspapers bring out a fresh edition, that fresh edition springs entirely from the telegraphic communication established by the Eastern Company. We have at the moment an interruption to our system in crossing the Isthmus of Suez. I am sorry that interruption should exist. If we had had our own way it would never have existed, and I hope that we shall be, before very long, able to show the Government that the Indian Empire is of some consequence to England, and that England should not be backward in retaining good telegraphic communication, which is so valuable at the present. I say this without fear of contradiction: if the system of telegraphy was suspended for one week between England and India I dread what the consequences would be. If it were suspended at the present, any dilatoriness or delay of our Government in giving the instructions would have serious results. There is another system working to India, that is the Indo-European system. That is a valuable system in its way. We, I may tell you, are partners in that system, and therefore at the present moment we are not losers to any serious extent by the interruption of our system; but I think it is desirable that England and India should not be entirely dependent upon this one line, which passes at the present moment through Germany, Russia, Persia, and the Persian Gulf. Only yesterday one cable in the Persian Gulf was interrupted, another might be to-morrow, consequently an alternative line is desirable. That, we have in full working order; but we are working in perfect harmony with that system, forming an arm of the general system, and for the present moment of a system still forming a connection, but an uncertain one, between England and Persia. I am hopeful that before long we shall be able to communicate again with India by the Suez Canal. We, of the Globe Company, as advisers to the other companies, and as being interested in these other companies, made it our special business to see Government almost daily on the subject, and we urged on them the importance of having this communication re-established with India and Europe. With these remarks I beg to move that the report and accounts of the directors submitted to the meeting be, and hereby are, received and adopted, and the following dividends be declared payable this day, 3s. on the preference shares, being 6 per cent. for the year ending 18th July, 1882, and 2s. 9d. on the ordinary shares, making 4½ per cent. for the year ending the same date, both free from income-tax.

The Marquis of Tweeddale seconded the motion, which was carried unanimously.

The Chairman: The next resolution is that the Marquis of Tweeddale be, and hereby is, re-elected a director of this company.

The motion was seconded by Sir James Anderson, and carried unanimously.

The Chairman: I have also to move that Mr. Henry Daniel Gooch be and hereby is re-elected a director of this company.

Mr. W. Ford seconded the motion, which was likewise unanimously carried.

The Marquis of Tweeddale and Mr. Gooch having briefly thanked the shareholders for their re-appointment, Dr. W. F. Gredge moved that J. G. Griffiths, Esq., F.C.A., and W. Griffith, Esq., B.A., be re-elected auditors of the company, at a remuneration of thirty guineas.

Mr. Scott seconded the motion, which was put to the meeting by the Chairman, and carried unanimously.

Mr. Griffiths briefly expressed his thanks to the meeting.

A vote of thanks to the chairman was then moved by Mr. Gardner, seconded by Mr. Benson, and carried by acclamation.

Mr. Pender responded.

The proceedings then terminated.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 245.

FIRE RISKS FROM ELECTRIC LIGHTING.

We are glad to observe that the rules and regulations relating to the above subject, which were drawn up by the committee of eighteen eminent men of science, appointed by the Society of Telegraph Engineers and of Electricians, have been severely criticised by the correspondents of some of our contemporaries. At the time these rules were published in our columns we took the opportunity of expressing our opinions on their value to electric light engineers, and we see no reason to alter the course we then took. In our review we stated that in no part of the Committee's report was there any suggestion thrown out as to any simple or convenient means of following up the skeleton ideas therein contained. We could not at the time devote sufficient space to the matter for dwelling upon many of the points deserving of attention, but as the subject is one of considerable importance, it may be well to return to it. Speaking of the construction of a dynamo-electric machine, the Committee says:—"The insulation of its coils and conductors should be perfect." Doubtless every manufacturer of dynamo-electric machines does his utmost to attain this impossible object, and it is more than probable that they all have different methods wherewith to get the nearest approximation to the desired insulation. It would have been an easy matter for the Committee, or certain members of the Committee, to have instituted a series of experiments as to the simplest, most efficient, and most durable manner of insulating the coils on the armature or electro-magnets of such machines. It has been done by means of dipping the sections of cotton-covered copper wire in melted bitumen or paraffin wax, and in shellac varnish, but there are certain objections to all three. The coils of the French made Gramme machines, we believe, are generally steeped in bitumen, and we feel convinced that this is calculated to retain the heat developed in the bobbin when the machine is at work. When paraffin wax is employed, it melts when the sections of the armature attain a moderate temperature, and it then flies off like oil. Shellac varnish makes the cotton too hard and brittle. It was within the province of the Society of Telegraph Engineers' Committee to study these points, or to seek the necessary information from those practically engaged in constructing dynamo-electric machines. It would then have been an easy matter to decide as to which was the most desirable method to adopt for insulating section from section. The insulation of the commutator or collector slabs is also a nice point. In regard to the conducting wires there is absolutely nothing said beyond the well-known fact that they should be efficiently insulated.

How is this to be performed is the question. As we have before explained, an insulation which may appear perfectly good whenever the current used does not exceed 100 volts electromotive force, may be completely broken down when a higher tension is employed. It is absolutely necessary that for a permanency we must use something more substantial than a wire covered with several layers of tarred yarn or tape, and we must therefore fall back at present upon gutta-percha or india-rubber. It is well-known that the former preserves its insulating capacities for almost an indefinite period when under water, but if exposed to changes of wet and dry, or to a moderate heat, it soon becomes useless. India-rubber possesses considerable advantages in these respects over the former, but it is a more treacherous material to use, and a fault in it is much more difficult to find than in gutta-percha, owing to the elastic nature of the material, which partially closes up again if severed. Why did not the Committe appointed to consider these matters explain to those wanting the information the best methods of insulating wires for use under various conditions? The Society's Committee apparently makes a great point of safety plugs. We have never yet been able to understand why a fusible plug in the main circuit, which would be melted if the current attain any undue magnitude, and thus break the circuit, should be called the *very essence of safety*. There are risks inherent to this means of illumination other than that of fire, as the Committee expressly call attention to at the conclusion of the report. Why cannot such a device be abolished altogether, and an electrical safety valve—if we may use the term—be employed to divert part of the current into another channel when it becomes too great for the purposes required? Even supposing a current does attain undue magnitude, it could scarcely be a desirable thing to happen, that a mill, factory, coal mine, or private mansion, should be suddenly enveloped in darkness because a fusible plug had melted. One would hardly expect an extensive manufacturer, or user of steam boilers, to make a weak place in his steam pipes, so that they might burst if the steam exceeded a certain pressure on the square inch, even supposing they were carefully boxed up and no damage done beyond stopping the machinery. We have always advocated the frequent testing of every part of an electric light installation but we cannot agree with the Committee, that electrical testing is an operation, *skill in which is easily acquired and applied.* Men may be taught in a short time the use of recently devised instruments of a simple and portable character, but the operation would be of a purely mechanical or imitative nature, and without in the least understanding the principles involved in such tests.

The two meagre sentences devoted to lamps give us no information whatever. It is, however, suggested that "the lanterns and all parts which are to be handled should be insulated from the circuit." As the lamps constitute those parts of the circuit from which it is most likely that shocks would be experienced, we think that some hints might have been given how to practically carry out the Committee's suggestion. We have on several occasions known of accidents from this source, and in two instances a man was knocked backwards from a ladder he had mounted for the purpose of regulating a faulty lamp. We believe that mishaps of this kind, which might have turned into serious accidents, are of frequent occurrence.

There are two rules relating to "Danger to person."

We are told that it is essential that "there should never

be a difference of potential of more than 200 volts between any two points in the same room." As this regulation is to secure persons from danger inside *buildings*, we should like to know how in a large shop, illuminated, say, by means of six or eight arc lamps, the two points can be avoided where the difference of potential does not exceed 200 volts. Of course, the wires entering the room might be so far apart that it would be impossible to receive a shock from two such points, but the Committee does not mention how such a contingency is to be avoided.

The rules and regulations as they stand might form the basis or outline of an exhaustive treatise on the subject, and perhaps the Council of the Society of Telegraph Engineers and of Electricians may reconsider the subject and re-issue a pamphlet which shall recommend itself to all as an authority on this most important matter. As it stands it forms more a subject for ridicule than for serious consideration.

EXPERIMENTS WITH UNDERGROUND TELEPHONE LINES.

[In Vol. IX. of the ELECTRICAL REVIEW, and on pages 5, 148, 149, 297, 306, 316, and 338, we described fully the method of insulation for underground conductors adopted by Mr. David Brooks, and the various tests which his process had been submitted to from time to time. We believe that the officials of the British Postal Telegraph Department entertain favourable opinions on its merits. It has not yet, however, had time to fully prove its capabilities, but as far as the trials have gone on thirty wires between Waterloo and Clapham the results have been quite satisfactory. We extract from an American contemporary, the *Operator*, an article giving some details of practical telephonic experiments which have recently taken place in America, and which will be perused with interest.]

"A SERIES of tests of a subterranean telephone line was undertaken on the afternoon of July 12th in the little booth of the Western Union Telegraph Company on the dock at Communipaw, N. J. We find the following report in the New York *Times*:—

"'It is now four years since, in Philadelphia, a mile of subterranean cable was laid from a point near the old Pennsylvania Railroad depôt in the direction of Gray's dock on the river. The experiment was made under a patent obtained by Mr. David Brooks, of Philadelphia, who had just invented a new mode of insulation for telegraph or telephone wires, the main specification of which consists in the use of a fluid hydrocarbon or gas. As laid down between Newark and Jersey City, the Brooks system is very simple. The length of the pipe in which the wires are enclosed is nine and a half miles. The pipe may be of any convenient diameter, and is smoothed internally by means of a sand bath. The wires (No. 16 copper) are wound with cotton or jute and pulled through the pipe by means of a powerful capstan. The length that may be pulled through at any one time, and the largest distance between the joints, consequently, is about 3,000 feet, or a little more than half a mile. When the wires have been pulled through the pipe and the latter has been laid in place, the remaining space (not occupied by the conductors) is filled with paraffine oil, which operates as an insulator, excludes all moisture, and perfectly performs its office. On the top of Bergen Hill is a tank which contains seven barrels of oil and communicates with the pipe containing the telephone wires. The pipe from Newark to Jersey City possesses a capacity of about ten barrels. There is thus the constant pressure of the seven barrels of fifty gallons each on the pipe in which the wires are enclosed, and thus any alteration in volume occasioned by the expansion of the oil at summer heat and its contraction in winter is compensated for, and no water can possibly enter the receptacle. It costs about 10 dols. per wire per mile for a tube containing 100 wires to lay such a cable, whereas it costs no less than 50 dols. per mile to put up telegraph wires in the ordinary way.

"'The success of the experiment in Philadelphia in 1878 led to the sale of the patent to the Western Union Company for telegraph purposes at a price of 190,000 dollars, and the inventor went to Europe immediately after to introduce it there. Sections were laid in Belgium, France, and England, and were eminently successful.

"'In the meantime an attempt was made to lay a cable from Newark to Jersey City by the Western Union Company, and some five miles of wires were put down in the salt meadows, but the Jersey City and Newark authorities refused permission to disturb the streets, and the project had to be temporarily abandoned. When Mr. Brooks returned from Europe he hit upon the idea of availing himself of the right of way of the railway between Newark and Jersey City. He thus obtained access to both, and connected the Western Union offices in Newark with the station on the dock at Communipaw. The cable is not laid in the best manner, but the experiments were no less successful than if the inventor had superintended every rod of the work. The material used for insulation is the second distillation of petroleum, or rather the residue that is left—a thick, heavy oil, good for lubricating purposes—after the burning fluid has been distilled off. This residue contains traces of soda and sulphuric acid, which would corrode the wires if left in the oil; and this fact renders a second distillation necessary, which slightly increases the cost per gallon. In the experiments yesterday afternoon the two points it was proposed to determine were the amount of interference by induction and the general practicability of the system. It is a familiar fact to the reader that when he puts his ear to the loud receiver of the telephone to listen to a person at the other end, voices not intended for his benefit, and really passing on other wires, are passed over to the conductor that he is using. This faint electrical reverberation is styled induction, and how to get rid of it has been one of the problems of telephone engineering. There is also a frying sound that is due to induction, and there are other difficulties that are familiar only to experts. Combined together, these difficulties have hitherto materially interfered with transmission at long distances, and it was claimed that they could not be overcome if subterranean wires were used.

"'The experiments yesterday were witnessed by a few persons only, among whom were Mr. Vail and Mr. Jaques, manager and electrician of the Bell Telephone Company, of Boston; Mr. J. W. Dyer, a Philadelphian electrician of high repute; Mr. Chinnock, electrician of the Metropolitan Company of this city, and Mr. Davis, its president; Mr. Robinson, of Philadelphia; Mr. Brooks, the inventor, who took no material part in the tests, and a few other gentlemen. In order that experts of the best skill might be at both ends of the cable, Mr. Chinnock went to Newark and operated the Newark end, while Mr. Dyer and Mr. Jaques operated the instruments at Communipaw. The wires had been connected until a circuit of 150 miles in length was established, and this was first tested.

"'There were some embarrassing circumstances, one of them being the fact that the Western Union system, using a dynamo equal to 185 volts at this end and a 60-cell Calland battery at the other, was in constant operation, parallel with the telephone wires. The first test was made with grounded wires, Mr. Dyer talking with the operative at the Newark end while Mr. Jaques listened for induction interference. The voice of Mr. Chinnock could be faintly heard as a result of induction, but Mr. Jaques pronounced it not sufficient to interfere with the practical working of lines. One wire after another was thus tested, with substantially the same result, both with the wires grounded and not grounded, in order to measure the induction as a separate factor. The next experiment was to connect several series of wires into metallic circuits, and to institute the same series of tests as to induction. No. 1 and No. 2 were first employed in this manner, and there was absolutely no sound brought to the ear by the second receiver. When No. 9 and No. 10 were similarly connected and the tests were applied the voice at the other end was heard in a faint, far-off manner, and only an occasional word could be distinguished. The same was the case with a circuit composed of No. 23 and No. 24. The experiments occupied the whole afternoon.'"

DIVISION AND SUBDIVISION OF THE ELECTRIC CURRENT.

IN our "Notes" will be found a letter from the pen of Mr. John Banting Rogers, who claims to be the inventor of the *division* and *subdivision* of the electric current. As long as Mr. Rogers was privately engaged with his work we refrained from setting aside any portion of our columns, to show the evident want of the merest elementary knowledge of electrical matters displayed in the fantastic creations of his brain. The subject has recently, however, assumed a public form, a J. B. Rogers Company having been promoted and the name of a well-known expert, who had reported on the system, dragged into the controversy now going on in the daily press in a manner not particularly creditable to either party; and we therefore feel compelled to comment on this subject in such a way as to bring it to a close once and for all, if possible, as far as we are concerned. We cannot, however, be so severe upon the originator of these so-called inventions as upon those who have so strenuously encouraged him in his erroneous ideas. Certain of our contemporaries have probably done more to keep the name of Mr. Rogers before the public than even a portion of the daily press; and these should really be held responsible for any injury which either Mr. Rogers, or those associated with him, may have sustained. We will, in the first place, allude to the claim set up by Mr. Rogers and others on his behalf, as to his being the first inventor of the division and subdivision of the electric current. We have before remarked, when speaking of the Company promoted for working the J. B. Rogers inventions, that a claim for the division and subdivision of the electric current could not be sustained, as in all electrical work the current may be made to flow in one or many directions, as the circumstances require. We will, however, bring before the notice of Mr. Rogers one particular patent (Werdermann. Apparatus for Electric lighting, dated 21st June, 1878) in order that he may know what had been done in incandescent or semi-incandescent lighting prior to the 20th September, 1880, the date of his first electrical invention.

The third claim of Mr. Werdermann reads as follows :—

"The apparatus or arrangements comprising the series of parallel circuits in connection with my improved lamps or other suitable lighting devices with or without artificial or special resistances, in the manner illustrated and described in connection with figs. 13 and 14 of the drawings, whereby I am enabled to effect the division of the electric current to produce any desired number of lights in connection with one battery, or other source of electricity, in such a manner that each one of such lights may be regulated, or extinguished, without affecting any, or either, of the other lights," &c., &c.

Leaving this for the moment we will return to the specification of J. B. Rogers, which is set forth in the following words :—

"The object of this invention is improved means and apparatus for dividing and subdividing the electric current for lighting or other purposes, by means of pairs of spherical, conical, hemi-spherical, bell, or flat, square, or other suitable shaped metallic bodies, to one portion of which are clips or other appliances for the attachment of the primary wires from a dynamo machine or other electric force producer, and with a series of other clips or appliances on the bands,

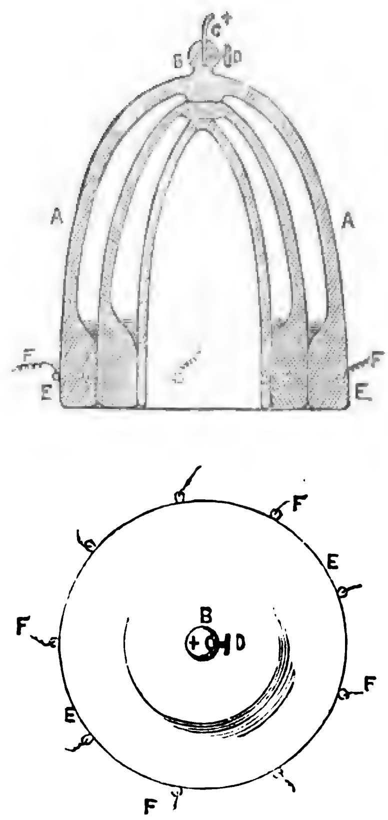


FIG. 1.

bases, or edges of the metallic bodies, to which other wires can be connected for conducting the fluid to any desired number of lamps or carbons, or to other shaped vessels or metallic bodies arranged in pairs, from which again wires can be conducted to other lamps or carbons. The apex of the bell or other shaped vessels or cups, if of bell shape, is preferably of greater thickness than the body for *accumulating and governing the fluid* (the italics are ours). The bands are also of greater thickness than the body for a similar purpose.

"Should the vessel have a spherical or globular form, the clips above referred to may be fixed upon a central band or belt; and instead of the single clips being on the apex it may be fixed to the collar or stem on which the globe stands.

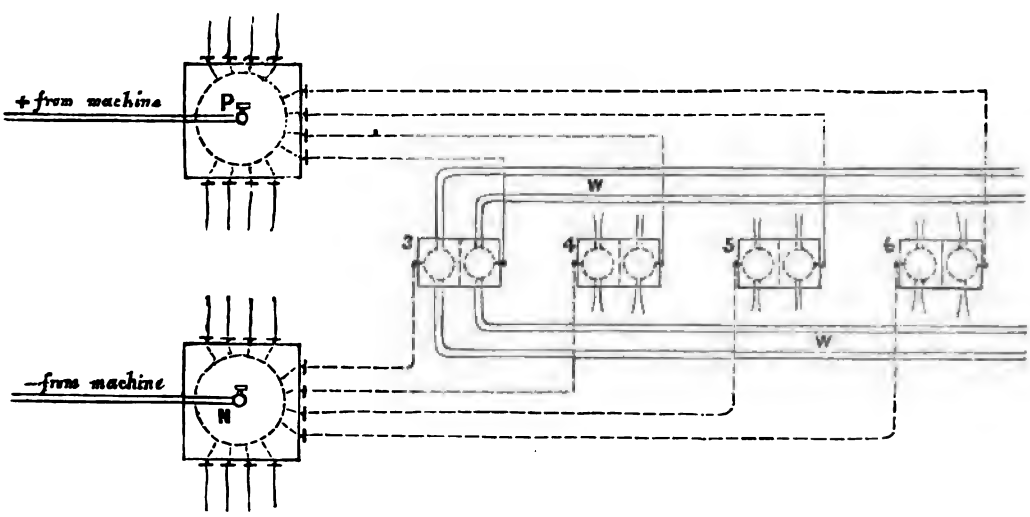


FIG. 2.

"For intensifying light, the series of clips on the bands of the vessels may have the primary wires of electric force producers, or of several of them, attached to them so that the united fluids may be transmitted through the apex wire of the bell-shaped vessel, or through the collar wire of the spherical vessel to one or more lamps or carbons.

"Any number of my metallic bodies may be used between the force producer and the light or lights if desired, for intensifying on the one hand, or dividing on the other."

The specification sets forth in the usual manner that the invention will be clearly understood by the accompanying drawings, and as we consider fig. 1 the most comical of any we reproduce it in plan and section.

We extract from the specification the explanation of these devices :—

"Fig. 1 is a section and plan of a bell-shaped apparatus, A, with lining vessels in the interior for current intensifying and distributing purposes ; B is the apex, with a conducting wire, C, attached by the screw clip, D, and E is the band or base around which a series of other conducting wires, F, are looped, or they may be attached in any other convenient manner, said wires, F, F, leading to and connected with electric lamps for producing light from one main dynamic or other force producer, as before mentioned, or for distribution of current for other purposes."

It is specially stated with reference to the drawings that "the above described figures only indicate a few of the devices which I intend to adopt for the purposes of my invention—viz., an apparatus for gathering or accumulating the electric force or fluid given off, or from, a dynamo-electric or other current producer, and by, in, or through said apparatus, so dividing or subdividing the current that several lamps or lighting appliances or apparatus in or by which the electric light can be established is effected, or its distribution for other purposes."

The specification is adorned with a second sheet of drawings, mainly consisting of a diagram showing these marvellous boxes connected up for use. We extract a portion of the sketch, which we prefer to have explained in the inventor's words :—

"Fig. 2 is a diagram of my system of subdividing and distributing the current ; P, N, are a pair of primary apparatus with twelve subsidiary wires each, positive from one and negative from the other. Each pair of branch wires from the primary apparatus is led and attached by any of the usual connection appliances to smaller apparatus, 3, 4, 5, 6, in which the current is gathered or accumulated, and passes by the subsidiary wires, W, W, of these smaller apparatus to other but still smaller apparatus from which are other subsidiary wires to lead the current for its intended use, or to other and smaller apparatus for a further distribution of the same, this system being carried on to any desired extent."

The inventor claims—

"1st. The system or means for gathering or collecting electric current into intermediate vehicles arranged in pairs, and in distributing said current therefrom by subsidiary conducting wires, as described, especially for lighting purposes, as set forth.

"2nd. The several apparatus shown on sheet 1 of the annexed drawings, and their employment in pairs as vehicles for the division and subdivision of the electric current, substantially as on sheet 2 of the annexed drawings, for the purpose or purposes set forth."

So much for this so-called patent which has had the support of two or three leading daily papers, and several of our scientific contemporaries, amongst them one dealing exclusively with electric lighting matters. Perhaps they might, if according any further notice to the matter, explain the difference between the circuit connections of Mr. Rogers and those adopted by Edison, Swan, and others. There is certainly a difference, in so far that in the one case the wires constituting the mains, submains, &c., are properly connected to each other where required, and in the other an extra piece of metal is put in circuit to increase the chances of bad joints or disconnections.

We must ask the pardon of our scientific readers for bringing forward the "*multiple terminal*" arrangement of Mr. J. Banting Rogers, and when we state our reasons for so doing we feel sure of their tolerance. The present year has been unprecedented in the introduction of the subject of electric lighting amongst all classes, and we are well aware that journals in which reliable information can be obtained relating to the various systems brought forward are now extensively perused by the general reader or public ; and it is therefore in the interests of the latter that we have lent our columns to the consideration of that which would long since have sunk into oblivion had it not been for the causes we have already alluded to. Mr. Rogers may believe, and probably does, that he is the victim of prejudice, but in this he is entirely mistaken. Years before 1880 everything that appears in his specification was known and in use for innumerable purposes connected with electrical science. Mr. Rogers invites the public to come and see how far he has succeeded in lighting by electricity the cottage or the mansion, and in this invitation he is perfectly safe ; for if the public were competent to judge these things, Mr. Rogers and his system of division and subdivision would have been vetoed long since. If Mr. Rogers lives long enough he will perhaps eventually come to the conclusion that the opinion of scientists and demonstrated facts are very much alike, when the laws governing any branch of science are as well known as those of electricity. We trust that this matter will now gradually be forgotten, and should Mr. Rogers in the future devise anything relating to electrical science worthy of favourable mention, we shall be amongst the first to welcome it.

Doubtless he has worked energetically for a long period in the belief that he had achieved some decided step in advance of the present methods of utilising the electric current for the purposes of illuminating our streets and houses. It would have been well had the ridicule which he well knew his work provoked in certain quarters led him to reflect for a moment that he might possibly be making an error ; and then, had he been sufficiently wise to consult some electrician of known reputation, he might have been saved much trouble and annoyance, and we should have been spared the mental energy wasted in perusing his patent.

OBITUARY.

ANTOINE BREGUET.

We reserved our notice of the death of this gifted young scientist until we were able to place more information before our readers than has been possible hitherto. We are indebted to our French contemporary, the *Revue Scientifique*, for the long article we publish. We have it on good authority, however, that this Journal, with which M. Breguet was for long associated, credits him with more than he actually achieved, notably in the statements relating to perfecting the Gramme machines and the telephone of Bell. Be this as it may, electrical science has lost in Antoine Breguet one who could ill be spared.

He was descended from a Protestant family, who at the time of the Revocation of the Edict of Nantes sacrificed their interests to their religious opinions and took refuge in Switzerland. His great-grandfather, Abraham Breguet, came back to France at the time of the Revolution and established himself at Paris as a clockmaker. His important discoveries placed his reputation on a firm footing, and he was made a member of the Academy of Sciences. His grandfather, Antoine Breguet, also distinguished himself in his art. His father, M. Louis Breguet, the well known scientist, the inventor of a telegraph which has been in use thirty years, is at present a member of the Institut. It has been his sad lot to survive his son, on whom he looked as the hope and support of an honoured name.

Antoine Breguet was born at Paris, January 26, 1851. He pursued a brilliant course of studies at the Lycées Saint Louis and Bonaparte ; but a violent attack of rheumatism overtook him in 1870, at the age of 19, and seriously affected his health, leaving behind the germs of heart disease. This malady, as Antoine Breguet well knew, demands a life of calmness and tranquility, free from cares and fatigue. But he had a very keen sense of the responsibility imposed by an illustrious name, and also a laudable ambition to add to the fame bequeathed to him by three generations. Led on by this idea, and sustained besides by his high moral energy,

he gave himself up assiduously to work, without either relaxation or rest. He had a motto, which we have often heard repeated in joke: *Noblesse oblige;* and this is the explanation and the history of his life.

Scarcely recovered from his illness, he enlisted at the time of the war, although at his age he was not called upon to do so, and took part in the defence of Paris as lieutenant of the auxiliary corps.

After the war he resumed his duties and prepared himself for the Ecole Polytechnique, where he was received in 1872. On leaving the Ecole in 1874 he refused the public offices to which his rank gave him a right, and entered, as sub-manager, the factories built by his father for the construction of instruments for exact measurements and electrical apparatus.

At that time new and important applications of electricity were springing up on every side. The Gramme machine, the improved telegraphs, and the telephone, made their appearance successively. Antoine Breguet was one of the most ardent promoters of the new discoveries. He was one of the first to understand what an immense future electricity had before it, and he devoted himself to the study of this science in particular, without neglecting the administration and general direction of his firm. He himself directed, in his factories, the first attempts at constructing the new models presented by inventors; and thus on several occasions, important improvements suggested themselves to him.

Although the management of the factories was a difficult and absorbing task, Antoine Breguet contrived to devote a great part of his time to purely scientific studies. He attended the lectures of M. Mascart, at the College of France, and by reading the original papers he completely mastered the new theories, then little known, of the great English electricians, Faraday, Clerk-Maxwell, and Sir William Thomson. For Faraday, in particular, he expressed the greatest admiration, and to that illustrious physicist, whose profound researches into the nature of electrical phenomena impressed him deeply, he traced all the progress made in electricity during the last fifty years.

But soon, by his own personal efforts, he became known to the public as an inventor and *savant* of great merit.

We may mention an ingenious anemometer, invented by him in 1875 and moved by electricity, which registers, at a distance, and continuously, the speed of the wind. One of these instruments is at work at the Jardin d'Acclimatation.

In February, 1878, he addressed a note to the Académie des Sciences on the "Telephone and the String Telephones."

He had discovered the curious fact that every point of the telephone (magnetised bar, handle, &c.), or of a substance connected with it, vibrates at the same time as the plate of soft iron, and may serve to transmit sounds.

He verified this most elegantly by means of a simple toy called the string telephone. If, in fact, the extremity of a string telephone is fixed to any point whatever of the Bell apparatus, the sound is plainly heard at the other extremity. From this he showed a means of communicating to several persons at once, the sounds arriving at one single telephone. All that is required is a few string telephones connected to any points whatever of the Bell apparatus. The string of the telephone may, besides, by certain special arrangements indicated in the note, pass through comparatively great distances.

The same year he invented a telephone called a mercury telephone, which is essentially different from all those known before, and seems still more surprising than Bell's. The complete description of it is to be found in the *Comptes Rendus* of the Académie des Sciences (March, 1878). The receiver and transmitter of this telephone are identical, and consist of two very simple Lippmann electrometers, furnished with a membrane at the upper part of the tube. The vibrations of the membrane of the transmitter are communicated to the mercury or to the glass and produce variations of current, which the wire of the line transmits to the other station. The electrometer being reversible, the membrane of the receiver undergoes exactly the displacements of the transmitter.

This telephone does not necessitate the employment of a battery, like the Bell telephone. It offers the following advantages over the latter:—

It transmits any vibrations whatever.

It is independent of the resistance of the line.

This last property allows of substituting for the thick wires of the ordinary lines fine steel wires of small diameter, thus effecting a considerable saving of expense. He thought that this discovery would be turned to account in the ordinary telegraph, and that electro-capillary phenomena would be utilised for the transmission of force to a distance. He had the intention of making researches into this question; but, alas! he had no time. Shortly after he published in the *Annales de Physique et de Chimie* a very important article entitled "Researches into the Theory of the Gramme Machine, the Cause of the Unsymmetrical Position of the Brushes, and an incidental Study of Magnetic Screens." The outline of this article was presented to the Academy, November 11th, 1878.

The Gramme machine, which has been known for several years and is familiar to the *savants* of every country, still presented certain difficulties. To Antoine Breguet must be conceded the merit of being the first to give an exact and complete theory on the subject.

In this article he dwells first on the reversibility of the machine, and shows simply that it is derived from well-known instruments—the revolving disc of Faraday and Barlow's wheel. But these latter furnish a very weak current, and inventors have tried, by the addition of an inner ring of soft iron, or by a special method of coiling the wire, to realise, with small volume, a machine of great power. He examines the methods given by Frölich and Alteneck; and indicates a new and far preferable mode of coiling. He then shows the exact function of the ring in the different machines. It is useful in all, for it heightens the intensity of the magnetic field; but in the Gramme machine it is indispensable, and acts as a magnetic screen to protect the inner spirals of the coils.

He then analyses the causes of the unsymmetrical position given to the brushes. This anomaly had always been attributed to the retardation of the *demagnetisation of the ring of soft iron.* But the coercive force of the ring is, really, the least important cause. He shows, in fact—and this is the most original part of his discovery—that the deviation is chiefly due to the reactions which take place between the magnetic fields of the exciting magnets and of the current of the coils. He then gives, from the results of his experiments, the simple rules which enable one to determine, in every case, the most advantageous position to give to the brushes.

In this long paper he turns to the greatest account Faraday's lines of force, of which he had made a special study. He calls attention at the commencement to their principal properties, and in the course of the paper he states two new laws, which may be added to the two laid down by Faraday. They deserve to be quoted verbatim: *The density of the lines of force at a certain point is proportionate to the greatness of the force at that point. A line of force contained in a magnetic substance is magnetically shorter than that contained in a diamagnetic substance, or more generally in a substance less magnetic than the first.*

In a conference held at the Sorbonne in 1880 he gave the result of his researches on the lines of force, and showed the wonderful benefit to be derived from them. By their means he showed from the commencement the close analogies between electricity and magnetism, and easily recognised their principal properties. He explained simply the magnetic screens, the attraction of the soft iron, and the orientation of the diamagnetic substances. Besides, this theory of the lines of force enabled him to state that the metallic rings in motion cease to be magnetic screens, and the subsequent experiments of M. Lippmann confirmed this assertion. Thus he thought that the study of the lines of force, on account of its simplicity and its utility, would one day form a part of the rudimentary instruction in electricity.

From 1875 to 1880 he published several articles on fresh discoveries in different journals and reviews (*Bulletin de l'Association scientifique, Revue des Deux Mondes, Annales de Chimie et de Physique*). He held several excellent conferences on the same subjects at the Scientific Association of France, at the Sorbonne, at M. Würtz's laboratory, at the Ecole de Médicine.

In 1880 he undertook the editing of the *Revue Scientifique*, in conjunction with M. Charles Richet. He contributed an important share of the articles of every kind published

in this journal. He inserted in the *Revue* the first article published in a French journal on Graham Bell's remarkable discovery of the photophone. When the famous Bell arrived in France, A. Breguet installed in his factories the series of photophonic instruments, and invited various scientific men to witness the very interesting experiments of demonstration. Graham Bell, who was able to judge of Breguet by this circumstance, entertained the greatest friendship for him.

In 1881, A. Breguet was made the head of the service of installations of the electrical exhibition. Quite a young man, he had for five years been the manager of a great firm, and he had acquired the experience of middle age; he was well acquainted with all the scientific and industrial questions relating to electricity; he possessed besides a quality rarely found in a scientific man—the great art of judging men, and the habit of quickly seizing the main points of a question as well as its details. Add to this his invaluable natural qualities, his coolness, his unflagging gaiety and high spirits, and his marvellous tact. During the whole course of the electrical exhibition he rendered the greatest services to this truly national enterprise. He first conceived the happy idea of establishing telephonic communication between the Palais de l'Industrie and the theatres.

His work was not, however, limited to directing the installation of the exhibits. His scientific knowledge caused him to be called upon to take part in the important meetings of electricians held during the exhibition. He was also delegated by the administration to the International Congress of Electricians. At the end of the Exhibition he obtained the Cross of the Legion of Honour.

During this exhibition he had been convinced more than any one that the applications of electricity had a grand future before them. Capital was soon at his disposal, and he founded an important industrial society, of which he undertook the direction.

At this time his prosperity seemed unclouded. At the age of 30 he was known as a scientific man; he was the equal and friend of great scientific notabilities; he was at the head of a prosperous industry. And, besides, in his private life he enjoyed all the pleasures of home. Married to a wife whom he loved, and father of three children, fortune seemed to smile upon him on every side. But the malady which had checked him at the commencement of his career had insensibly made rapid progress. The excess of work during the exhibition had caused general fatigue. He disregarded these warnings, and the fears manifested by his family and his doctor. His moral energy, in fact, the predominant feature in his character, was as strong as ever, and his confidence in himself and his future had even increased. He knew no better than before how to spare himself work. The directing of his firm, the construction of new workshops, the editing of the *Revue*, absorbed his day; the evening he devoted to the preparation of a course of lectures to be given for the first time, at the Observatoire, to the naval officers at Paris. This course was instituted by Admiral Mouchez for the purpose of instructing naval officers in the principal recent discoveries in the domain of electricity.

All these hopes, all these joys, were brought abruptly to an end. The body, worn out by work, became weaker and weaker. In May he was obliged to keep to his room and give up all intellectual efforts. However, his courage and his hope of a speedy cure had not left him, when he died suddenly on the 8th of July.

His death is a cruel loss to his country, to science and to industry.

But his relations, his friends, his workmen, who stood in crowds round his tomb, were at least able to speak of him in these words: "*Antoine Breguet, dead on the field of honour.*"

GLASGOW SCIENCE LECTURES.—Arrangements have just been completed for the delivery of a course of science lectures at Glasgow during the coming winter. On the list of lecturers we observe the name of Prof. Silvanus P. Thompson, who is to discourse "On the Earth as a great Magnet."

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I am glad that the pieces of evidence which I have been able to adduce from the original writings of Reis have drawn from Count du Moncel the promise to insert them in the next edition of his book, "Le Téléphone." I must, however, express my surprise that the author of a historic work on the telephone, such as Count du Moncel's claims to be, should have so long done the original inventor of the electric telephone, which "formed the starting-point of all the others," the injustice of not acquainting himself with the *ipsissima verba* of that remarkable man. Compared with the stuff that has been written from time to time about Reis's telephone, the original memoirs of Reis are as clear as daylight. Nor do I think that even Count du Moncel will long be able to withhold from Philipp Reis the honour of having been the first—whether he understood the *theory* of it or not—to transmit articulate speech electrically.

I do not know that it is necessary for me to prove that Reis understood the principle of undulatory currents in order to believe that his telephone would and did transmit speech. I believe that M. Gramme, who invented a very admirable dynamo-electric machine, did not understand the equations of mutual induction, and yet I do not doubt that his machine generates electric currents. But in the case of Reis the diagrams of curves attached to his memoirs conclusively show that he did realise what was to be done, though he only succeeded in finding an imperfect means of attaining it.

Count du Moncel throws down a challenge of fact, which I shall be most happy to accept. He says, and italicises the words himself, that "for sounds to be reproduced by a receiver, consisting of *an iron wire enclosed in a helix, and stretched on a sounding case placed on a table* (the only Reis receiver known), the currents sent by his transmitter must have been *interrupted.*" . . . Why must they? This form of receiver—commonly known as Reis's knitting-needle receiver—will articulate just as well, though not so loudly, as a Bell receiver, if supplied with adequate currents. If Count du Moncel will try the experiment with two or three bichromate cells and a good transmitter, such as Hunnings' or Ader's microphone, he will have a sufficient proof that Reis's receiver *will receive* articulate speech. When Count du Moncel says that with this receiver the currents "*must*" have been interrupted, I simply deny this to be the fact, and reply that if this receiver is to articulate the current *must not* be "interrupted," in the sense of being completely broken.

I am surprised that Count du Moncel does not know of the existence of the other Reis receiver with the electro-magnet in it. My earliest acquaintance with it was in Kuhn's "Angewandte Elektricitätslehre" (p. 1018) in Karsten's well-known cyclopædia, published in 1866. The original description of it is in Legat's report in the "Zeitschrift" of the Austro-German Telegraph Union of 1862. Perhaps Count du Moncel only knows it as Legat's receiver, as I myself for a long time thought it, until I read the original article and found it to be really Reis's.

Again, Count du Moncel says that if Reis had really penetrated the principle of the articulating telephone he could have substituted for the metallic contacts some of moderate conductivity. *Why should he*, indeed? This fallacy—that a semi-conductor is advantageous, first introduced by Edison—has nothing to do with the matter. Take an ordinary Blake transmitter and replace the carbon button by a silver sixpence. It articulates just as well as before. Yet silver is the very *best* conductor. Conductivity, or semi-conductivity, has nothing to do with the matter, and the only advantages of carbon over silver are that it does not fuse or rust at the point of contact; and that, moreover, at the point of contact a minute voltaic arc *may*, in certain cases, prevent complete interruption in the circuit.

Reis did, indeed, penetrate the principle of the articulating telephone: for, as in every practical telephone transmitter in use to-day, so in his telephone transmitter, there was a *loose contact* in the circuit, *so arranged that the voice could act upon it, and thereby regulate the strength of the current.* If you eliminate this part of the apparatus—screw up the loose contacts of your practical telephone transmitters so that our voices cannot affect them—what will your telephones be worth? No, the essential principle of the telephone is *imperfect contact*, and that essential principle was invented and applied for the purpose of transmitting speech by Philipp Reis in 1863.

If this does not suffice as a claim for the invention of the telephone transmitter, I wonder what will. We can dispense with the electro-magnetic receiver, and use other receivers; we can dispense with diaphragms, and tympanums (also Reis's invention, by the way), in the transmitter; we can dispense with semi-conductors, *et id genus omne;* we can dispense with springs and tension-screws: but with the principle of *loose contact* we cannot dispense. That which alone is indispensable, Philipp Reis discovered.

SILVANUS P. THOMPSON.

July 26th, 1882.

THE CITY AND GUILDS OF LONDON INSTITUTE TECHNOLOGICAL EXAMINATIONS, 1882.

To the Editors of The Electrical Review.

Sirs,—The students who sat at the technological examinations held under the auspices of the City and Guilds of London Institute in May last are now aware of their examiners' decisions. These decisions, so far as they relate to electrical engineering, may perhaps, when summarised, not be uninteresting to your readers:—

TELEGRAPHY.

Town.	Passes, 1882. Grade. Honours		Ordinary.		Students Examined. Connected with Industry.		Unconnected with Industry.		Total Students Examined.		Remarks.
	1st Cl.	2nd Cl.	1st Cl.	2nd Cl.	Passed.	Failed.	Passed.	Failed.	1882.	1881.	
Belfast	...	1									
Bolton	...	1									
Edinburgh ...	...	2	...	3							
Falmouth......	...	1	...	3							
Glasgow	1	...	2	2	...	...	...	...	...	...	5th prize O.G.
Hebden Bridge	...	...	1								
Huddersfield..	1										
Leeds	...	1									
London.........	1	...	...	7	...	...	...	...	...	...	1st prize H.G.
Manchester ...	1	...	1	3	...	...	...	...	...	...	2nd prize H.G. & 2nd prize O.G.
Nottingham...	...	1	2	...	...	...	...	...	...	...	1st prize O.G.
Oldham	...	...	...	1							
Plymouth......	...	...	1	...	...	...	...	...	...	...	3rd prize O.G.
Salford	...	1	1	...	...	...	...	...	...	...	4th prize O.G.
Sheffield	...	...	...	1							
Southborough	...	...	...	1							
W. Hartlepool	...	...	...	2							

ELECTRIC LIGHTING, &c.

Town.	Passes, 1882. Grade. Honours		Ordinary.		Students Examined. Connected with Industry.		Unconnected with Industry.		Total Students Examined.		Remarks.
	1st Cl.	2nd Cl.	1st Cl.	2nd Cl.	Passed.	Failed.	Passed.	Failed.	1882.	1881.	
Glasgow	...	...	3	13	...	...	...	..	...	...	3rd prize O.G.
Leeds	2	...	2	2	...	...	...	...	...	...	2nd prize H.G. & 1st prize O.G.
London	1	1	2	...	...	...	...	...	...	...	1st prize H.G. 2nd prize O.G.
Plymouth ...	...	...	...	1							

ELECTRICAL INSTRUMENT MAKING.

Town.	Passes, 1882. Grade. Honours		Ordinary.		Students Examined. Connected with Industry.		Unconnected with Industry.		Total Students Examined.		Remarks.
	1st Cl.	2nd Cl.	1st Cl.	2nd Cl.	Passed.	Failed.	Passed.	Failed.	1882.	1881.	
London.........	1										

My chief object, however, in submitting the above schedules to you is to suggest, through the medium of your valuable paper, the desirability of the Institute giving in the annual report the information requisite for the filling up of the blank columns, and thereby rendering the schedules both interesting and instructive.

It is satisfactory, no doubt, to know that 43 students have passed in telegraphy, 27 in electric lighting, &c., and 1 in electrical instrument making; but it would be much more satisfying to know how many candidates attended the examinations, and how many of them were connected with the industry examined on. I feel assured that the utility of such statements would more than repay the little extra labour incurred in their compilation.

It is, perhaps, somewhat early to comment on the results of the examinations with the meagre details at present in our possession, but it may be pointed out that the only two ladies whose names appear on the *Pass List* are connected with telegraphy. This is a gratifying feature, and it is to be hoped that on the next list, not only will these names re-appear, but those of many other fair competitors. The laurels gained for London are a little remarkable. The student examined at Cowper Street takes the place of honour, while the seven students examined at the Central Telegraph station take second-class places in the lowest grade! This is, unfortunately, not an exceptional case, and when taken in connection with the remark in the examiners' last report, that he knew the papers of those engaged in telegraphy, will, it is to be feared, produce a most detrimental effect, so far as telegraphists are concerned, and it can hardly create surprise if the falling off in next year's *Pass List* is even greater than that in the one just issued.

Colonel Webber, in his inaugural address to the Society of Telegraph Engineers, speaking of telegraph engineering, says:—"So blind is the tyro to the realities of practice and to the intricacies of the agent he uses that technically educated men, thrown into the turmoil of the insidious difficulties to be encountered, will break down, and fail even to detect them. In an educational institution such as I have before my mind, I would, if possible, not only allow the *theory* and *practice* to march hand in hand, but I would allow the practice to precede the theory with some minds, and *vice versâ*. The course would thus engage the interest of both kinds of minds, and confer the maximum of benefit. Such an institution should include instruction in the lecture theatre, in the workshop, in the laboratory, &c." This is undoubtedly what should be; but is the consummation likely to be attained so long as the present system of examination prevails? Will students who are more ambitious to win prizes than gain genuine knowledge, and teachers who are more anxious to increase their incomes than impart lasting instruction, give to *practice* the attention which it deserves? No; because payment and rewards are now made not according to useful knowledge, but according to cram, or examinational knowledge; and until steps are taken to make practical examinations go hand in hand with the written examinations this unsatisfactory state of affairs must continue, and such cases as the following, by no means an isolated one, recur.

A student who some five years ago obtained from the Science and Art Department a first class certificate for electricity and magnetism, and who has since devoted the greater portion of his time to the study of technical telegraphy, and discharges from time to time the duties of a testing officer, attended, along with a fellow clerk, whose studies dated from

the close of the preceding year, a recent technological examination, with the result that while the man of six months' study gained an honour's place, the man of six years' theoretical knowledge and practical experience was plucked. For this anomaly the examiner is in no way responsible, his duty being to adjudge the papers submitted to him without partiality; and I bring it forward not to point to any unfairness on his part, but to draw attention to the necessity for practical examinations, for there can be but one explanation of the failure of the man who is familiar with the laws of electricity and who applies them daily in the discharge of his duties, and that explanation is his inability to express himself on paper with such clearness as to warrant his examiner in granting him a place on the Pass List.

As the subject is one of considerable interest I leave it to be discussed by those better qualified than

Yours truly,

July 28th, 1882. FAREHAM.

ELECTRIC LIGHTING IN THE CITY.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—With reference to the notices which have recently appeared in your journal, giving certain figures as to the electric lighting in the City, I beg to state that these statistics, as given, may be very misleading without explanation, as they do not by any means convey to the general reader a fair understanding of the subject. The apparent high percentage of so-called "failures or extinctions" shown as to the Brush light is almost wholly due to the fact that the lighting was discontinued from the 2nd May, 1881, for a period of seventeen days, it having been determined, in consequence of defects which soon appeared in the first cable laid down, to replace it with another. This, surely, should only be estimated as a single failure (one, too, which had nothing to do with the Brush system, and which could be guarded against for the future); whereas it is reckoned, in the figures given in your article, as 561 failures, counting each of the 33 unlighted lamps as one failure for each of the 17 nights during which no lighting was even attempted. This reduces the reported 660 failures to exactly 100, the whole of which arose from causes which (after the experience gained in this the first large attempt ever made at street lighting in this country) are easily remediable. It is worthy, also, of notice that, although the lamps in question are all on a single circuit, in no case has an accidental stoppage of the mechanism in one lamp affected any of the others. The 209 hours 30 minutes extinction, through the failure of the driving apparatus, occurred at the commencement of the trial, when some necessary alterations were being made in the arrangement of the boilers and other machinery at the factory.

It should further be pointed out that the number of so-called failures was considerably increased by one of the lamp-posts being overthrown by a van, causing an extinction of this lamp for 103 hours. Deducting, then, from the gross extinction of 3,142 hours 30 minutes, 2,630 hours for relaying the cable, 103 hours for the broken lamp-post, and 209 hours for the alterations to boilers, &c., which events are altogether outside any defect in the Brush system of electric lighting, there remains only 200 hours of extinction, spread over a series of 33 lamps, out of the total number of 141,900 lighting hours, being a percentage of ·14 during the whole year of an experimental running, the first of its kind ever attempted in this country. I would further point out that of these defects the bulk were in the early part of the experiment, and that they have gradually become less and less, pointing to the conclusion that with a little more time and experience we may expect that they will disappear entirely.

Since the continuation of the lighting for the second year the lamps have burnt very regularly, and, so far, we have had no complaints.

I would mention that the subject is very fairly and comprehensively dealt with in the report of the Streets' Committee, presented by Colonel Haywood, a copy of which appeared in *Engineering* of July 14.

Yours faithfully,

JAMES HUMPHREYS.

London, *Aug. 3rd*, 1882.

[We take pleasure in inserting Mr. Humphreys' interesting letter. He has, however, apparently overlooked the source from whence we derived our figures, viz.: the report to the Streets Committee, to which he alludes in his letter. Mr. Humphreys seems not to have read the article in our contemporary carefully, or he would notice that the analysis of the failures is not from the pen of Mr. Haywood. We cordially agree with our correspondent that with more time and experience defects which now exist should disappear entirely.—EDS. ELEC. REV.]

NOTES.

CRYSTAL PALACE INTERNATIONAL ELECTRIC EXHIBITION, 1882.—The directors have pleasure in announcing that they have received from the jurors the following award of prizes:—

DIPLOMAS OF HONOUR.

AWARDED TO EXHIBITORS NOT COMPETING FOR TRADE MOTIVES.

Her Majesty's Postmaster-General.
The Secretary for War.
The Anglo-American Telegraph Co.
The Eastern Telegraph Co.
The Telegraph Construction and Maintenance Co.
The Submarine Telegraph Co.
The South-Eastern Railway.
The London, Brighton, and South-Coast Railway.

For the general excellence of their exhibits.

C. F. Varley.—For his induction machine and condensers.
R. H. Froude.—For dynamometer.

GOLD MEDALS.

J. R. Voss.—For induction machine.
Elkington & Co.—For their deposition of gold alloys and general excellence.
H. Wiggin & Co.—Improvements in electro deposition of nickel and cobalt.
The Faure Electric Accumulator Co.—For Faure battery.
T. A. Edison.—For complete system of lighting and other exhibits.
British Electric Light Co.—For Gramme dynamo machine and exhibit.
R. E. Crompton.—For Bürgin dynamo machine and Crompton arc lamp.
Anglo-American Brush Co.—For Brush dynamo machine and arc lamp.
Swan's Electric Light Co.—For incandescent lamp.
Electric Light and Power Generator Co.—For Weston and Maxim dynamo machines and lamps.
White House Mills.—For dynamo machine.
Rowatt and Fyfe.—For Pilsen arc and Joel semi-incandescent lamps.
G. G. André.—For arc lamp and regulator.
Gérard & Co.—For arc lamp.
Davey, Paxman & Co.—For steam engines.
Galloway & Sons.—For steam engines.
Marshall & Co.—For steam engines.
Robey & Co.—For steam engines.
Ransomes, Head, and Jefferies.—For steam engines.
Hornsby and Sons.—For steam engines.
E. S. Hindley.—For steam engines.
Crossley Brothers.—For Otto gas engine.
Thomson, Sterne, & Co.—For Clerk's gas engine.
Roos and Ostrogovich.—For their application of the automatic system to Hughes' type printing apparatus.
Johnson and Phillips.—For the general excellence of their exhibits.
Direct United States Cable Co.—For the excellence of their exhibits.
Edward B. Bright.—For his fire alarm system.
The Exchange Telegraph Co.—For the general excellence of their exhibits.
Professor Dolbear.—For his new electrostatic telephone.

SILVER MEDALS.

Coxeter & Sons.—Class X.
W. Elmore.—Class XI.
United Asbestos Co.—Class XIII.
J. & H. Gwynne.—For steam engines.
Fyfe & Main.—For arc lamp.
National Electric Light Co.—For dynamo machine and lamps.
Gravier & Co.—For arc lamp and exhibit.
R. Hodson.—For steam engines.
Hammond Electric Light Co.—For installation of Brush machines and lamps.
A. Cance.—For arc lamp.
Domestic Electric Lighting Co.—For the general exhibit.
Electric Lighting Supply Co.
Electric Lighting Engineering Co.
Strode & Co.
W. Ladd & Co.—For early historical dynamo machine.
W. J. Hammer.—For historical collection of incandescent lamps.
W. T. Henley.—For his cable core.
W. R. Sykes.—For his electric locking and blocking system of railway signals.

The Consolidated Telephone Construction and Maintenance Co.—For the general excellence of their exhibits.
Saxby & Farmer.—For their railway signals.
R. Johnson & Nephew.—For their iron wire exhibit.
F. Smith & Co.—For their iron wire exhibit.
R. S. Newall & Co.—For the general excellence of their exhibit.
W. T. Glover & Co.—For the general excellence of their exhibit.
Phillips Brothers.—For the general excellence of their exhibit.
Professor Monnier.—For his detector and analyser of fire damp.
J. W. Gray & Sons.—For the excellence of their exhibit.
Sanderson & Co.—For the excellence of their exhibit.

BRONZE MEDALS.

Binko & Co.—For their improved agglomerate battery.
E. Dent & Co.—For their non-magnetising watches.
E. Paterson.
G. Skrivanoff.—For his dry battery.
R. Webster.—For his non-magnetising watches.
Roth, Sohlaefli & Co.—For their electric self-winding clocks.
J. F. Pratt.—Class X.
H. Whiteside Cook.—For his electric governor for screw marine engines.
Arnold & Sons.—Class X.
L. H. Borrell.—For electric self-winding remontoire clock.
T. R. Brailsford.—For water-level indicator.
J. Storer.—For electrical table fountain.
J. Willing.—For electrical signs.
B. Verity & Sons.—For brasswork.
G. Hawkes & Co.
Zanni & Co.
E. Müller.
E. Blouzon.
C. R. Goodwin.
Mignon & Co.
J. E. Liardet.
A. R. Sennett.
J. H. Athole Macdonald.
Philadelphia Dynamic Co
Alfred Apps.
J. E. and S. Spencer.
Julius Sax.
W. Groves.
Doulton & Co.
Automatic Telegraph Co.
J. Davis & Co.
School of Submarine Telegraphy.
Electric Railway Signal Co.
G. C. Lewis & Son.
Waterlow & Sons.

W. GARDINER,
Secretary.

Crystal Palace, *July 24th*, 1882.

THE AWARDS AT THE CRYSTAL PALACE ELECTRICAL EXHIBITION.—We fancy that a considerable amount of surprise, if not of something stronger, will be felt by the majority of the exhibitors at the recent Electrical Exhibition upon perusal of the lists of awards. We will not say anything of the Diplomas of Honour, as they do not enter the question. The awards of the medals (gold, silver, bronze) are, however, open to comment. We notice that Mr. Crompton is the possessor of a gold medal for the Bürgin dynamo-electric machine and the Crompton arc lamp. Messrs. Fyfe and Main must needs be content with a silver award for the Standard Fyfe-Main lamp. These latter gentlemen were dependent upon a Gramme machine for the production of the electric current, and Mr. Crompton had also to rely on another man's invention for his supply of current; therefore, we cannot think that the one should be credited with a higher degree of excellence than the other, if the two merits of the lamps are considered. Mr. Crompton, certainly, manufactures the Bürgin machines, and his exhibit was complete long before that of Messrs. Fyfe-Main; and, all things considered, the jurors may have had their reasons for the decisions given. The White House Mills Company receive a gold medal for dynamo-electric machines. This exhibit was, certainly, one of the most attractive of all—in a way that our readers will well understand. We, ourselves, never visited the Palace without making a mental note of the progress made, and the results obtained, at the stand of the White House Mills Co. It is still more surprising to note that Mr. E. Paterson, Messrs. Verity and Sons, the School of Submarine Telegraphy, and others, are favoured with bronze medals only. Messrs. J. and H. Gwynne and Mr. R. Hodson will doubtless appreciate the discernment displayed by the jurors in awarding to them silver medals for their fine specimens of direct-acting engines. Many of the recipients of silver and bronze awards will probably regret that they did not follow the example of Messrs. Siemens Bros. and retire from the competition. In our issue of the 8th April we expressed an opinion that the appointment of jurymen to report upon the comparative merits of the Electrical Exhibition was a mistake. We think that many of the exhibitors will now agree with us, that it would have been better to leave the Press and the public to make their own criticisms. We reprint above the report of the jury.

THE FINANCIAL RESULTS OF THE CRYSTAL PALACE ELECTRICAL EXHIBITION.—According to the report of the directors of the Crystal Palace, the receipts, compared with the corresponding six months last year, show an increase of £18,991. Comparing the expenditure, there is a diminution of £3,354. The number of visitors have been considerably in excess of the largest number that have attended the palace in any half-year since the opening.

ELECTRICAL EXHIBITION AT THE ROYAL AQUARIUM.—In our "Notes" of the 22nd ult., we called attention to the above proposed exhibition. In our supplementary pages today, further particulars of interest to intending exhibitors will be found. The building seems quite suitable for the new venture of the Aquarium management, and it reminds one, both in size and shape, of the Palais de l'Industrie, in Paris. It has a great advantage in being easily accessible from all parts of London.

SCIENTIFIC REPORTS ON ELECTRIC LIGHTING.—We extract from the "Money Article" of last Monday's *Standard* the following letter:—

Sir,—In your issue of Monday, the 24th instant, a letter of Professor Gordon appeared, and it could have only been written to injure, which I feel is not your wish. As a fact to base from, the patent I took out for the division and subdivision of the electric current was the first, and before this, it was viewed, not only by practical electricians, but the public and the press, that the electric light could never be used for domestic purposes until some means was devised to that end. I was given to understand that Professor Gordon himself was a worker in this direction, in what way I do not know, never having inquired, but certain it is that the means I had worked out and secured the patent for he was the first to veto. Another fact worthy of notice is that at the Paris Exhibition my appliances were not used, but many that exhibited at Paris made free use of my invention at the Crystal Palace to demonstrate facts they could not do at Paris. Between these exhibitions my patent became a public document, and the interest shown in the question speaks for itself by the first issue of the patent books being eagerly bought up and a second edition having to be published. The means I have devised are known to be simple, and many companies are using them, and abusing the inventor to cover their doings. A reckoning must come about sooner or later, but legal technicalities at present bar the way.

It may be well to state how Mr. Gordon came upon the scene. He was commissioned by gentlemen who contemplated forming a company on my inventions to inspect and report on the incandescent lamp I had produced. When he came he distinctly stated his mission—to see as to the merits of my lamp. He tested one at my works; others were sent to an address he gave. He gave a report and was paid his fee. It seems he offered some gratuitous remarks relative to the subdivision, which I have seen since in his letter to the press.

You and the press in general have from time to time noticed my doings in this question, and I think I may fearlessly say I am the only person (firm or company) that has allowed free inspection of my works from the engine-room to the burning of the lights, the making of the filament to the mounting, the glass blowing, the division and subdivision of the electric current—in fact, all that tends to show the system; and my visitors' book bears attestation by signatures of men of known repute of all nationalities sufficient to convince any person that what Mr. Gordon assumes has no weight.

In conclusion, I would ask, may I invite the public through your columns to come and see for themselves how far I have met the question of lighting by electricity the cottage or the mansion, and thus judge between demonstrated fact and scientists' opinion; for Mr. Gordon has not, even as one of the public, visited my works during the six months I have kept open show-rooms on the Viaduct more than the occasion referred to, than having a lamp taken down and testing it. I, therefore, leave the public to judge between us.

I am, Sir, the public's obedient servant,
JOHN BANTING ROGERS.

47, Holborn Viaduct, *July* 29, 1882.

We have often wondered why Mr. Rogers has kept o unaccountably in the background as far as letter-writing is concerned, but we no longer wonder why he has hidden his "light" under a bushel in the face of this effusion. Such a silly and unmeaning epistle we have rarely had the misfortune to peruse.

We deal in our other columns with the *invention* of Mr. Rogers for the division and subdivision of the electric current.

The idea of producing a visitors' book to convince any person that Mr. Gordon's opinion has no weight is novel and

amusing, and shows that Mr. Rogers is *really* endowed with inventive faculties.

It will be remembered that in our "Notes" of last week we published Mr. Gordon's letter to the daily press and also the reply to it from the solicitors of the J. B. Rogers Company. Mr. Gordon has again taken up the matter, and the following appeared in Wednesday's *Times* :—

July 27th, 1882.

SIR,—I observe in the *Times* of Tuesday last a letter purporting to have been written by Messrs. West, King, Adams, and Co., in reply to mine of the 21st inst.

Will you kindly permit me to say that I never sent a draft report to any one, and that it is not the fact, as stated by your correspondents, that I struck out of my report the part relating to the system.

The facts are as follows: My report was dated and sent in on the 3rd of June, and consisted of two parts, one having regard to the lamps, the other to the system. Subsequently, at the request of the gentlemen interested in the formation of the company, and upon the understanding that they would organise a company to manufacture the lamps, and would abandon the system, I divided the report into two parts, both being signed by me and left with them.

At an interview on the 9th of June with the then intended directors I found that they were unaware of my report on the system, and at the request of the then intended chairman I, on the same evening, sent him a copy of it. He duly acknowledged its receipt, and stated that he would read it to his colleagues.

I heard nothing more of the matter until on the 10th inst. the advertisement of the company came out, and it then appeared that of the nine gentlemen whose names on the 9th of June were printed on the proof prospectus as directors only one remained, and that the system was put prominently before the public.

My report was not quoted until July 20th, the day of the closing of the lists. I should not, however, have entered upon this correspondence if either my report on the system had been accessible to the public or the system had not been referred to in the prospectus.

I enclose a list of the Board of Directors as constituted on the 9th of June for your information, but, for obvious reasons, not for publication.

I am, Sir, your obedient servant,
J. E. H. GORDON.

ELECTRIC LIGHTING CONTRACTS.—We are asked to state that the Metropolitan (Brush) Electric Light and Power Company Limited has secured contracts to light up the Royal Mint, the premises of Messrs. Halling, Pearce, and Stone, and the Floral Hall, Covent Garden.

ELECTRIC LAMPS WITH CARBON FILAMENTS.—We were correct in assuming last week in a note on the above subject that the Edison Electric Light Company would probably have applied, before the ELECTRICAL REVIEW was issued, for an injunction to restrain the Swan United Electric Light Company from infringing the Edison patents. On Friday morning the 28th ult. the case was brought before Mr. Justice Chitty, when the defendants challenged these patents, and it was arranged that the motion should stand till the trial of the action, the defendants undertaking to keep an account. We understand that only one patent is involved, that dated 10th November, 1879, No. 4796. The Edison Company, we believe, seek to restrain the defendants from "making, selling, or using any electric lamp made according to or in the manner described in the specification filed in pursuance of the said letters patent, or according or in any manner only colourably differing from the same." With regard to the Swan lamp, we think we are correct in stating Mr. Swan's contention is, that the carbon filament is not made or secured to metallic wires as set forth in the above patent (10th November, 1879). We believe it will also be part of the defendants' case to endeavour to show that Edison's patent is void by reason of prior publication and also of insufficient description. We cannot foretell the ultimate result of this trial, but we hear that before bringing their action the Edison Company asked the defendant company to keep an account, &c., and this was declined. Of course, had the Swan Company so agreed, the Edison Company might have said that the defendants had given in. As the case now stands, however, it allows the defendant company to state that the motion for an injunction has failed.

THE YORKSHIRE BRUSH ELECTRIC LIGHT COMPANY.—We have received information that The Yorkshire Brush Electric Light and Power Company (Limited) is about to establish a large central lighting station at Middlesbro', for the purpose of supplying the electric light to the various iron works on the marshes. The entire scheme will be carried out under the direction of Mr. W. Kingsland. This gentleman will be remembered by our readers as having had charge of the lighting of Chesterfield, by the Brush "Arc," and Lane-Fox incandescent electric lamps. A full description of this installation was given in the ELECTRICAL REVIEW of April 15th.

THE PHŒNIX ELECTRIC LIGHT AND POWER COMPANY.—In the Chancery Division of the High Court of Justice, before Mr. Justice Chitty, on Saturday last, a petition presented by Messrs. Foster, Hight & Company, accountants, who were creditors for the winding up of the Phœnix Electric Light and Power Company, was by arrangement dismissed.

THE ELECTRIC LIGHT IN THE CITY.—In a leading article entitled "The Mysteries of Electric Lighting," the *City Press* says:—"If the Brush Company, after twelve months' experience, can light with their system, *at a profit*, for £800 a district of the City that was formerly lighted with gas at a cost of about £700, why do they refuse to tender for lighting the rest of the City at a price that would produce them a very large profit, and yet doubtless be readily accepted by the Streets Committee? The calculation has been made that the price they charged for a light, equal to a hundred (?) candles, burning for twelve hours, was three farthings. If this can be done at a profit, no one will be more astonished than one of the most eminent electricians of the day, who, when asked the question, answered in the classical language of Goldsmith, Fudge!"

SPEED OF WORKING THROUGH CABLES.—Mr. John Pender, the Chairman of the Globe Telegraph and Trust Company, made a curious remark in the course of his speech at the above company's meeting last week. If correctly reported, Mr. Pender said, speaking of a new Company: "But as for the cable they intend to put down, it would be simply impossible for them to do their work. They assume that they will do twenty-five words a minute. Sir James Anderson, who has had great experience of what the *best manipulators* [the italics are our own] can do, will tell you that sixteen words a minute is uncommonly good work. Therefore the whole statement throughout is one that, I am sorry to say, shows the greatest ignorance on the part of those who concocted it, and I think it is using a mild phrase to call it ignorance. Probably they would not be able to work their system at more than ten words a minute." We have hitherto been under the impression that the speed of transmission through cables did not depend upon the manipulator, but rather upon the various retarding influences inherent in all long submarine lines. To the best of our knowledge the speed of working through the 1865 and 1866 Atlantic cables attained the rate of seventeen words each. Mr. Pender could probably tell what this means if the cables were employed for *duplex* working. We have reasons for believing that those responsible for the statement concerning the speed of transmission through this proposed new cable are, perhaps, the most experienced and capable men we could name for this class of electrical engineering, and that they know exactly what they are talking about.

EXTENSION OF THE NETWORK OF FRENCH CABLES ALONG THE NORTH COAST OF AFRICA.—The India-rubber, Gutta-percha and Telegraph Works Company have contracted with the French Government for the making and laying of 260 nautical miles of submarine cables and, as stated in the general meeting of the 25th ult., it is the intention to lay this cable with their ss. *International*, which is now on her homeward voyage from the West Indies. The cable is to be laid along the Coast of Tunis from Soussa to Sphax, and from Sphax to Gabes, or Kabes. The town of Soussa, or Susa, is situated on the coast 4½ miles from Ras al Marsa, rising gradually from the shore to the citadel at the south-west, within which is a conspicuous tower elevated 260 feet. The walls surrounding the town are from 30 to 40 feet in height, having bastions and towers at the several angles. Upon either side of the town are well wooded ridges, dotted with houses. The town has a particularly white appearance. Soussa contains several handsome mosques and well kept bazaars, and has manufactories of linen, with an active trade

in oil, wood, pottery, shoes, &c. The population is said to be about 10,000, and a British Vice-Consul resides in the town. The ruins of the ancient port are still visible. It was formed between two moles to the northward of the present town, but is now so filled up with sand as to afford but slight shelter even to boats. The southern mole projects nearly two cables from the shore, and has on its outer extremity an exposed battery of 12 guns.

Sphax, the ancient "Taphrura," is enclosed within high walls, is well built, having paved streets, and is reputed the prettiest town in the Regency. When nearing Sphax by sea a high tower and minaret form conspicuous objects. The country around for about five miles is studded with detached houses and gardens, well wooded and backed by a range of hills at about nine miles distant. Sphax contains manufactories of linen, and boats for the coasting trade are also constructed here. It carries on an active trade with Malta and Sicily in oil, esparto grass, sponges from the adjacent islands of Kerkenah, carilla, wood, and barley; fruit and vegetables are grown in the surrounding district. Cucumbers, locally called "sfakous," are said to give the name to the town. Rain falls only in winter, and the heat is tempered by a sea breeze throughout the day. The population of the town is about 6,000 inhabitants.

Khabs or Kabes is a town said to be of considerable size, situated a little within the coast upon the river or Wady Rif; there are a good many surrounding villages, and an active trade is carried on with Tunis, &c. A principal article of commerce is the red dye, called hennah (*Lawsonia inermis*), the plant from which it is procured being extensively cultivated in the neighbourhood. The town is defended by a well-built fort or tower. The port, which has not more than three or four feet of water, is formed by the mouth of a small stream running through the village of Jara.

ON THE APPEARANCES OF THE ELECTRIC ARC IN THE VAPOUR OF THE SULPHURET OF CARBON.—By MM. Jamin and G. Maneuvrier.—We made known to the Academy in the session of June 19th the modifications which the electric arc undergoes in the pneumatic vacuum when it is produced by a Gramme machine with high-tension alternating currents. We have found that the phenomena are modified if gases or vapours are introduced into the glass in which the experiment is made. These phenomena are very remarkable in the vapour of sulphuret of carbon.

The burner used in these experiments is formed of two vertical parallel carbons fixed at their base; the upper extremities, which are opposed to each other, can be brought into contact or separated by a simple mechanism. The apparatus is placed under a large bell of the pneumatic machine, and is exhausted as completely as possible. Under such circumstances the arc is not formed, but in its place there appear the lights of a Geissler tube. On introducing into the bell a few drops of sulphuret of carbon, so as to obtain an increased pressure of 0·05 to 0·06 metre, we see the arc enkindled between the points, and remain burning when they are withdrawn from each other.

At this moment there is, as it were, an explosion of light so bright as to be insupportable, and incomparably superior to the ordinary lustre of the arc. On examining it through darkened glasses, we see a brilliant arc of 0·05 to 0·06 metre in height, resembling a horse-shoe, or a capital Omega. The two extremities are at the two points of the carbon, and there is besides a long flame, like that of a furnace, which plays over the arc, escapes from it, and ascends vertically.

The points of the two carbons appear red and very brilliant, but the arc is of a pale green, and as its light overpowers that of the carbons, all the room is illuminated with this tint. The splendour increases so as to become intolerable as the tension of the vapour increases, but as the resistance of the vapour increases at the same time, the arc is often extinguished, and requires to be re-kindled every moment, by bringing the carbons in contact.

On examination with the spectroscope, this light presents all the rays of the carburetted gases in combustion, but more complete and better defined. The spectrum is very discontinuous. At its red extremity is a striped spot; first a very bright line followed by several others, more slender and close together, then a broader line which repeats the former, and which is also followed by fine rays; these appearances are repeated as we proceed towards the orange, but becoming fainter until they disappear. After a dark interval the same appearances are repeated in the yellow, and in the beginning of the green; then follows another dark interval, succeeded by a repetition of the same effects in the green, and finally in the violet.

To sum up, the spectrum is composed of four striped portions in the red, the yellow, the green, and the violet, so identical that, save for the colour, they might be taken for the same pattern transported from the red towards the violet. It is very probable that they obey one and the same harmonious law which remains to be discovered.

Of these four regions the green is much the most luminous, and gives the special tint to the arc, and colours all objects green.

Whilst these appearances are manifested a chemical action is produced. If air remains in the bell, and if the apparatus is not well closed, the sulphuret of carbon burns imperfectly; a cloud of sulphur fills the bell, and is deposited on the sides, whilst the carbon burns alone. If the air has been well exhausted, these clouds are not formed, but a brown deposit is fixed upon the sides, becomes black, adheres to the glass and dims it. This deposit is volatile, and has an odour resembling that of sulphur.

It is evidently a compound of carbon and sulphur, perhaps a proto-sulphuret corresponding to carbonic oxide, perhaps an isomeric modification of the ordinary sulphuret. We see, indeed, no deposit either of sulphur or carbon, and the pencils of the burner have neither lost nor gained anything. It is probable that the sulphuret of carbon is dissociated, the sulphur volatilised, the carbon diffused in vapour in the arc, and that this carbon and sulphur recombine in the flame to reconstitute a compound under different conditions: but this is mere conjecture not yet analytically demonstrated.

This experiment is remarkable for the extraordinary quantity of light produced, for the magnitude of the arc, for its colour, the character of its spectrum, and the chemical reactions which take rise. It will not probably be available for lighting on account of its colour, except for lighthouses, or for signals to a distance.—*Comptes Rendus*.

NEW COMPANY REGISTERED.

STANDARD TIME AND TELEPHONE COMPANY (LIMITED).—Capital £100,000, in £1 shares. Objects: To acquire and work inventions having reference to the transmission and regulation of time or timekeepers by electricity or otherwise, and for the accumulation and dispersion of electric currents; also to carry on the usual business of a telephone company, and to manufacture electric, magnetic, and pneumatic appliances of all kinds. Signatories (with five shares each): P. J. Morrison, St. Albans; E. Ray, 5, Percy Street, Bedford Square; E. A. Bacot, 35, Oakfield Road, Clapton; R. W. Cole, 153, Hemingford Road, N.; F. Bigg, 39A, Threadneedle Street; J. Usher, 25, Barnsbury Park; E. S. Parker, 75, Cornhill. The signatories are to appoint the first directors and determine their remuneration. Qualification, 1,000 shares. Registered 26th of July, by Newman and Co., 75, Cornhill.

NEW PATENTS—1882.

493. "Preparation and manufacture of asbestos as an insulating material for electrical apparatus and for other purposes." C. J. ALLPORT. Dated February 1.

3557. "Telephonic appliances." J. MUNRO and B. WARWICK. Dated July 27.

3570. "Electric arc lamps." F. M. NEWTON. Dated July 27.

3575. "Electric lamps." J. G. LORRAIN. Dated July 27.

3576. "Improvements in distributing and measuring electricity and in apparatus to be employed for those purposes." J. HOPKINSON. Dated July 27.

3582. "Improved means of regulating electric currents and electromotive force and apparatus thereof." L. CAMPBELL. Dated July 28.

3583. "Electric lamps and machinery and apparatus connected therewith for obtaining and transmitting power." W. T. HENLEY. Dated July 28.

3591. "Electric producer and power machines." J. IMRAY. Dated July 28.

3592. "Secondary batteries." F. J. BOLTON. Dated July 28.

3595. "Electric telegraph and apparatus employed therein or connected therewith." J. H. JOHNSON. (Communicated by E. Estienne.) Dated July 29.

3616. "Generating electricity." J. R. (?) Rogers. Dated July 31.

3619. "Facilitating electric lighting." J. Verity. Dated July 31.

3655. "Electric lamps." O. G. Pritchard. Dated August 1.

3661. "Apparatus or appliances for use in telephonic circuits." J. W. Fletcher. Dated August 2.

3665. "Construction of the plates of secondary or electrical storage batteries." T. Cuttriss. (Partly communicated by C. Cuttriss.) Dated August 2.

3666. "Improvements in wires or conductors for electrical purposes, and in the insulation thereof, and in means or apparatus and materials employed therein." P. R. de F. d'Humy. Dated August 2.

3681. "Apparatus used for facilitating telephonic communication." J. Cowan. Dated August 2.

3685. "Dynamo-electric machines." W. R. Lake. (Communicated by H. C. Sample and F. Rabb.) Dated August 2.

3689. "Apparatus for regulating the transmission of electrical energy and the speed of steam-engines and other motors for electric lighting and other purposes." W. R. Lake. (Communicated by M. Levy.) Dated August 2.

3691. "Improvements in the construction of channels or courses of suitable form and materials through which wires to be used for electrical, magnetic, telegraphic, and telephonic purposes may be passed, secured and protected, and also when needed for insulating such wires and for other useful purposes." G. M. Edwards. Dated August 2.

CITY NOTES.

Old Broad Street.

THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (LIMITED).

On Thursday an extraordinary general meeting of the shareholders of this company was held at the City Terminus Hotel, Cannon Street, under the presidency of Sir Henry Tyler, M.P.

The secretary, Mr. W. J. Cordner, having read the notice convening the meeting,

The Chairman said: Gentlemen, as you have seen from the notice, our only business to-day is to confirm the resolution passed on the 18th July. The meeting is, therefore, called in accordance with the 51st clause of the Companies' Act, 1862. In accordance with that we have summoned you within a month, and also within more than fourteen days from the last meeting, to ask you to confirm the resolution which you passed on the 18th July. I do not think, as I stated fully on that occasion the object of the resolution—I do not think I need detain you on the present occasion at any great length. It is simply to enable us to distribute amongst you the sum of £245,000, which we hold at our disposal, and for which we have had warrants prepared, so as to be able to furnish you with the very satisfactory interim dividend of 100 per cent. upon all you have subscribed upon this undertaking. I beg to move this resolution: "That the 85th of the Articles of Association be repealed," and that in lieu thereof the following be henceforth adopted as the 85th Article:—"The directors may from time to time, on their own authority, pay to the members, in proportion to the amounts paid up or credited as paid up, on shares held by them respectively, such bonus and such interim dividend as, in the judgment of the directors, the position of the corporation justifies."

Mr. Scudamore Sellon: I will second that.

Mr. Hammond said before the chairman put that to the meeting he should like to say one word. Of course the resolution deals with the distribution of dividends, and those who hold shares in the company were glad to hear that 100 per cent. was being declared in that way; but it did not quite rest there. When shareholders received a dividend they were glad to have an idea of how the dividend was being earned (hear, hear). He thought it was well within the province of the meeting just to ask the directors, through the chairman of the company, to give a slight hint to the shareholders in that respect. He thought it desirable for more than one reason. They were told outside that this company, with which, as some of you know, I am vitally connected——

The Chairman: I think you are also engaged in another company?

Mr. Hammond replied that he had been careful to put it that he was vitally interested in that present company. The policy of the Brush system had been to cover the whole of England with sub-companies, working enthusiastically in various parts of the country. When first he had the pleasure of being connected with this company the Brush system was not so widely known in England as at the present time. He did claim, in spite of the call to order by the chairman, that he was vitally interested in this company. The Brush machine had been placed by him in a place where it was before unknown, and he was daily engaged in pressing forward the fortunes of the Brush system. The shareholders would see, and those outside that room, outside that company, would see that there are those who ignorantly assume that no profits were being made by the company in their manufacturers' branch. They were told that the declaration of a 100 per cent. was simply made by selling sub-concessions. The policy of sub-concessions had been held up to ridicule. They were told most distinctly that the company was losing money in its manufacturing branch. Therefore, although the shareholders were glad to receive 100 per cent., or a bonus, or whatever it was called, he thought they were entitled to have a hint as to whether the 12½ per cent. declared beforehand in the working branch would not become a mere bagatelle compared with the amount likely to be declared, which was at the present time being earned in that direction. There were outsiders who were constantly assuring the public that the whole thing was a sham. He was personally passing on orders to the company. He thought they had yesterday the invoice of five forty-lighters, a machine which had not been touched previously by any other company. While he was personally passing on those orders, he felt that all the sub-companies were doing the same, he thought there would be no objection on the part of the board to say a word to the shareholders and to those who are interested in the Brush system that the company is in a solid position, irrespective of the money earned out of those concessions, and which they might make in the future, and that behind all this business there is a question of giving not only 100 per cent. to-day but another to-morrow (applause).

Mr. Baker said he endorsed the remarks made by Mr. Hammond, and he should like to ask if the chairman could conveniently give them some idea of the large amount of concessions which would be retained because, of course, they were receiving a very fine bonus or dividend, and there might be good things to come by the end of the year or this time next year. If it were convenient he should like to have some idea of the amount. They had to supply them with the future of the company.

The Chairman replied that he did not know that the remarks made had been strictly in order. The proposition he had made was a very simple one: that the articles of association should be altered for a particular purpose. At the same time he was always ready to go out of his way, though if transgressing the rules of order on occasions when it was desirable to do so, to legitimately give information to shareholders. As to Mr. Hammond's remarks, it was true that they had formed a great number of sub-companies, and they did so with this idea: We said to ourselves, the introduction of this system of electric lighting, or any other system, over the United Kingdom, but also over a great number of foreign countries, is a gigantic business. It is not a business that such a limited capital as we possess can possibly undertake; and therefore, in order that this business may be properly transacted, it is desirable for us to engage other companies with us in this great work, and in order to do that we will, at a reasonable price, sell concessions to different parts of the United Kingdom, and sell our patents to those foreign countries where we have patents. We may as well induce a great number of people to come to work with us in forming the business; we will do our part in manufacturing the apparatus, while they do their part in making installations and applying the apparatus. Well, unfortunately, instead of the business being conducted in an entirely reasonable manner, as they hoped when they started, they had found it had led to a considerable amount of speculation; and that whereas they sold at reasonable prices when they started—and he might say that Mr. Hammond had been instrumental in selling those concessions and in working the business—they found people came crowding upon them and buying those concessions, and that enhanced their values; and complaints were made between one and another that they could not get all they wanted; and not only so, but people to whom they sold, with the only object of starting in different districts, began to sell sub-concessions, till they saw less of the lighting work done and more of the sale of sub-concessions than they could wish. That he took to be a rather unhealthy state of things. And not only so, but the value of their shares ran up to a very high price indeed; there was a sort of mania for buying these things. The board thought that a disadvantageous business. They hoped to see it reasonably conducted. However, they must take things as they were. He was very happy to inform them, as far as he could, their position. The shareholders knew they, the board, only made up their accounts once a year. They had now no annual balance-sheet to lay before them on that occasion. When Mr. Hammond said that people, ignorantly assuming certain things, considered the whole thing a sham, and wanted to know where their dividends came from, he could only say that those on that side of the table could only smile at such an expression. They would be glad to show their works, and be happy to show them to any shareholder who wished to look over them. There was a very large amount of work being performed in manufacturing apparatus. The company had no less than 800 men employed in the business. In fact, their manufacturing profits for the last six months had been £30,000 (hear, hear). Whether that was the worst or the best half he was not going to prophesy. When Mr. Baker got up and asked what would be the profits of the next half-year, he thought it was a little more than he could tell.

Mr. Baker remarked that he did not ask what amount they were about to receive, but what they had received for the sale of sub-concessions.

The Chairman added that he did not think on that occasion that he ought to answer that any further than at the last meeting. On reviewing their balance-sheet, they determined to divide the amount of £245,000; and in order to protect themselves they had taken care that there should be a considerable margin in hand, and, under all the circumstances, that was the amount the board now divided amongst the shareholders. As to going further into the question of what amounts were in hand at the end of the half-year, and what amounts were likely to be earned, he could not go into that question at all.

Mr. Wood asked if the first or second six months of the year were the most productive?

The Chairman said that that was prophecy again. He believed that the second half of last year had been most productive, but that did not prove anything regarding this year. It would depend on the orders received, and the consequent profits.

Mr. Wood said that he should be glad if the board could have taken the *bona fide* shareholders more into their confidence, and so endeavoured to dispel some of those rumours regarding the company. He was sorry to see that their stock had been made the subject of

speculation on the Stock Exchange, and that tended very much to undermine the confidence of the *bona fide* holders. If they could be taken more into their confidence it would be more agreeable to those who were not speculators but shareholders.

The Chairman said that they were taken entirely into their confidence. As to their shares being the subject of speculation, really the directors had nothing to do with that; and in everything that he had said he had tried to stop that speculation. It was very much to their disadvantage that that should go on, and it was the fault of the gentlemen who chose to speculate and thus run their shares up to what he thought too high a price. It was not for them either to sustain or depreciate the stock. They had nothing to do with it, and did not want anything to do with it. He had been the more guarded on this occasion because of the mania for speculation, and he would not say either one way or another one word that would help that speculation either to put up or put down the value of the stock. That was the reason why he had determined to be so guarded in what he said. If Mr. Wood could suggest any figures that might be given that would be of any use with regard to their past history he should be glad to supply them; but as to what might happen in the future he must decline to speculate.

A shareholder asked whether the greater portion of the money which it had been stated they had received for concessions was represented by cash, or whether it was made up of paid up shares with the subsidiary companies.

The Chairman said that was a perfectly legitimate question, and he had no hesitation in saying that they held a large proportion in paid up shares of the subsidiary companies which they had taken instead of cash, and which they were obliged to take in many cases.

The resolution was then put to the meeting, and unanimously adopted.

On the motion of Mr. Henry Maudsley, a vote of thanks to the chairman was carried by acclamation.

The Chairman briefly responded, and the proceedings terminated.

EASTERN TELEGRAPH COMPANY (LIMITED).

On Thursday last an extraordinary general meeting in connection with the above company was held at the offices of the company, 66, Old Broad Street, Mr. John Pender, M.P., presiding, for the purpose of confirming a special resolution, which was passed unanimously at a general meeting held on the 13th ultimo.

The Secretary, Mr. George Draper, having read the notice convening the meeting,

The Chairman said: Gentlemen, as you are aware this is a special meeting for a special purpose; and that is to move the confirmation of the resolution which was passed at the previous general meeting of the company. I shall therefore call upon the secretary to read that resolution.

The Secretary accordingly read the resolution, which was as follows:—

Resolved—A. That the board of directors be, and are hereby authorised from time to time to create and issue mortgage debenture stock of the company to an amount not exceeding one-third of the share capital of the company for the time being issued and paid up, upon the terms that the aggregate amount of the said stock for the time being in issue, and the interest thereon shall rank *pari passu* as a first charge on the undertaking and revenue of the company, the stock to be issued at such times, in such amounts, and on such terms and conditions as the board shall from time to time determine, for the purpose of redeeming by exchange or otherwise the outstanding debentures of the company, and any other purpose to which capital of the company may be lawfully applicable.

B. That the board be, and are hereby authorised to make such provision as they think fit for the registration and transfer of mortgage debenture stock, and for the delivery of certificates thereof, and for the issue of stock warrants to bearer transferable by delivery, and of interest coupons attached to such certificates and warrants or otherwise, and for the conversion of warrants to bearer into registered stock and of registered stock into warrants to bearer, and generally as to the form and incidents of all documents relating to the said stock, but so that no such provision be inconsistent with paragraph A of this resolution.

C. That the board be, and are hereby authorised from time to time to purchase in the market, and hold and deal with any amounts of such mortgage debenture stock for the purposes of any reserve fund or investment of the company, and, with the sanction of a general meeting, to apply other moneys of the company to the purchase in the market of any such stock for cancellation, and, with the like sanction, afterwards to re-issue mortgage debenture stock in lieu of all or any of the said stock so cancelled, provided always that the amount of mortgage debenture stock issued and outstanding shall never exceed the limit prescribed by paragraph A of this resolution.

The Chairman: You have heard the resolution read; I beg to move that the same be, and hereby is confirmed.

The Marquis of Tweeddale seconded the motion, which was put to the meeting and unanimously adopted.

The Chairman: That is all the business of the day, and we have now to act upon the resolution, and I hope that we shall be able to turn it to good account.

On the motion of Mr. Griffiths, seconded by Mr. Wells, a vote of thanks to the chairman was passed unanimously, to which the Chairman having responded, the proceedings terminated.

THE RAILWAY AND ELECTRIC APPLIANCES COMPANY (LIMITED).

On Friday, the 28th ultimo, under the presidency of Mr. Wm. Alex. Smith, of Glasgow, the statutory meeting of this company was held at Cannon Street Hotel.

The Secretary, Mr. Wm. Skinner, having read the notice convening the meeting,

The Chairman said: Gentlemen, I have to express the regrets of our noble chairman, the Duke of Manchester, who is unable to preside to-day owing to another very pressing engagement. He expressed his regret at the board meeting this morning, but hopes to have the pleasure of meeting you on a future occasion. Gentlemen, you are probably aware that this is what is called a statutory meeting, that it is a meeting which must be called within four months of the registration of the company, in conformity with the Act of Parliament. Of course, you are probably aware that although our company was registered four months ago we have not been in possession of our property until the last six or eight weeks, so that really the directors have only to report upon what has been done during a very limited period. I have to mention that two of our directors have lately visited Glasgow and inspected the works acquired by this company. You are aware that the works were situate in two different parts of Glasgow. The principal works which have become the property of this company were situated two miles to the south side of the city; the telephone apparatus and smaller electrical appliances manufactory was situate inside the city, thus necessitating very much waste of time in the transfer of goods from one of the works to another. The result of this is that it has been deemed expedient that the work should be concentrated under one roof, and thereby effect a very considerable saving. We have ample room for the extension of our works at Polmadie. Plans have been prepared and approved by the board whereby the object we now desire will have been obtained. In the meantime we have devoted our energies principally to consolidating the work we have in hand, getting up patterns for work we know we shall obtain, and generally organising the works, which will undoubtedly lead us to results which will enable us to have a profitable investment for our money. Some time ago we received authority from a commission of engineers appointed to inquire into electric lighting to send appliances to Chatham. This was done the week before last. Reports concerning the Maxim lamp are satisfactory to a degree. It is quite true that the Maxim lamp requires more power to drive it; but, on the other hand, it has advantages which will show it to be one of the best, if not the best incandescent lamp before the public. In the first place it is not so liable to break as other lamps. Two sessions ago the Glasgow Art Union asked us to fit up their galleries with electric lights, and after a series of experiments, which lasted over several months, we finally fixed upon the Maxim lamp as the best for the purpose; and the art galleries have been lighted by the Maxim lamp with perfect satisfaction to every one. During the last two sessions we have been able to replace 264 gas jets with 60 Maxim lamps, with the result that they not only got a better light, but a perfectly cool atmosphere even when the room was crowded, and the colours came out by electric light as they do by daylight. Now, the importance of that fact is almost sufficient, to those who have really thought the matter out, to convince any one that, be it this year or be it next year, electric lighting must take the place of gas. I care not how much you may improve the burners—and there have been vast strides made in that direction when they have been compelled to do it—but the fact remains that the light from the gas does change colours, and does prevent many people from distinguishing different shades. But this is not where it ends. Gas consumes the very life-giving property of the air—oxygen. When I tell you—which you would hardly believe—that the small gas burners consume as much oxygen as five men can consume, you can calculate how it vitiates the atmosphere when ten burners are going at a time in a drawing-room. My opinion is that the lamp we have acquired is one of the best, if not the best, yet brought before the public. I look forward to the time with a little patience and energy when there will be a vast field for the development of this incandescent light, especially amongst ships. I have the authority for saying this of Mr. Burns, one of the largest shipowners in the world, who says he does not expect to fit out another vessel without the electric light. This is only one of the many shipowners who have expressed their opinion. When we are in a position to conclude these orders, we may obtain a large share of the orders which Mr. Burns has to give. Another most valuable asset of our company is the Williams's Railway patents. They, to a certain extent, change the system of working railways in this country. They do away entirely with what is called the V crossings. They avoid all breaks in the main line of railway, and prevent many accidents, such as from the tire going the wrong side of the point. They enable you to put down a crossing at any part of the line you like without interfering with the main line; but that is not the only advantage they have. The present system of crossing takes a gang of men something like eight hours to fit in. That is, I mean, if any defect is discovered before an accident, and has to be adjusted, it takes that time to fit in. During that time the main line traffic is interrupted; whereas by the cross over system, which belongs to us, you can very easily fit up a crossing in half-an-hour without interfering with the main line. Why has not this system been adopted more largely? It was four or five years before Sir Henry Bessemer got steel rails adopted, and further, I may say, that the largest and most powerful railway has not yet adopted what has been practically admitted to be the only safe brake—the Westinghouse brake. The William's system is adopted on ten miles of line between Glasgow and Wemyss Bay. The Government inspector has inspected that line and reported very favourably on it. I have therefore, gentlemen, very little doubt in my own mind that with energy and pushing this matter, and by not being afraid to spend a certain sum of money in laying down experimental cross overs, and in demonstrating to the railway officials the advantage of these lines, we shall revolutionise the present system of railways. With these words I would ask you, gentlemen, to approve of the general action of the directors up tothis. If any gentleman has any question to ask I should be glad to answer him.

Mr. J. B. Hamilton (an original shareholder): In the prospectus the amount of capital asked for was £250,000, and I understand the amount of shares allotted is £100,000.

The Chairman: £180,000; about £170,000 was really all that was asked for.

Mr. Hamilton: The original was to be £250,000, of which the vendors were to have £95,000.

The Chairman: No, sir; £80,000.

Mr. Hamilton: The prospectus says £95,000.

The Chairman: Of which £80,000, at the option of this company, might be given in shares.

Mr. Hamilton: There is £195,000, including vendors' shares.

The Chairman: You are quite wrong, if you will excuse me saying so.

Mr. Hamilton: Well, then, call it £180,000 (laughter). The amount of profits in the first case would be 80-250th parts; if all the capital had been subscribed the vendors would get about one-third of the profits. Now that the capital is £180,000, you see that the proportion will be that the vendors will get 80-180th parts instead of 80-250th parts. Now, I would just suggest to the shareholders whether it is not a proper thing for us that the vendors should make an abatement to the extent of the difference. I say that the shareholders should consider whether they should not insist upon that, because on the face of the prospectus it was never contemplated that the vendors should get more than 95-250th parts. With the present limited capital they get much more (applause).

The Chairman: If any other gentleman has any question to ask, I may as well answer them all at once.

No further question being asked,

The Chairman said: I can only say I am very much indebted to Mr. Hamilton for having brought this matter up. Mr. Hamilton has clear ideas of what is right and wrong, and of what is fair and what is unfair. I have had the pleasure of knowing him for a number of years, and I can listen to any expression of his opinion with the utmost respect. I may tell Mr. Hamilton this, that his figures, although not exactly correct, his idea is correct. You must recollect this, Mr. Hamilton, that if the development of business requires it the directors have power to issue £500,000, which would only give the shareholders one-sixth instead of one-third part. The contract is made on a certain basis, that if we choose to issue our capital the vendors must be contented with one-sixth profits. Seeing that the capital is not fully subscribed, they are entitled to the proportion of £100,000. The new shares are just entitled to as large a proportion of the profits, the same as the vendors; there is no difference between them.

Mr. Hamilton: I have only suggested the thing to the meeting; if they think anything of it, they can think it over. I don't want to put it as a resolution.

The Chairman: No further question being asked, I think the business of the meeting is ended. I thank you for your attendance, and I hope we shall have a statement to put before you next time we meet that will please you.

After a vote of thanks to the chairman, moved by Mr. Cummings, the meeting separated.

DIRECT UNITED STATES CABLE COMPANY (LIMITED).

The tenth ordinary general meeting of this company was held at the City Terminus Hotel, Cannon Street, on Friday, 28th ult., Mr. John Pender, M.P., chairman of the company, presiding.

Mr. J. W. Fuller, secretary, having read the notice convening the meeting and the report having been taken as read,

The Chairman said: Before making any general remarks I think it is necessary to give you a few figures as showing the working of our system during the past six months. Our revenue for the half year ending June 30th, after deducting out-payments, has amounted to £61,825 8s. 2d., and the working and other expenses, including interest on debentures and income tax for the same period, amounted to £24,979 3s. 2d., leaving a balance of £36,046 5s. 1d. as the net profit for the half-year, making with £4,623 0s. 8d. brought forward from the previous half-year a total of £40,669 5s. 9d., which has been appropriated as follows: Interim dividend of 5s. per share at 31st March last, £15,177 10s. 0d.; final dividend of 5s. per share at 30th June, now proposed, £15,177 10s. 6d.; carried to reserve fund, £9,531 9s. 1d.; written off for preliminary and arbitration expenses, £500; carried forward to next year, £282 16s. 8d.; total, £40,669 5s. 9d. Owing to the shilling tariff the revenue is much less than at the corresponding period of 1881 when the tariff was two shillings. It was hoped with the shilling rate adopted that the traffic would respond to the reduced rate. But ten months' trial of the rate has found that not to be the case. The American Telegraph Cable Company opened one cable at a tariff of two shillings on May 15th, and that tariff was in force on the other cables from May 22nd. A second cable was opened on the 30th ultimo. That company has actually participated in the joint traffic in respect of one cable from May 15th and two from June 30th, in proportion as agreed upon. The agreement entered into with the land company on the American side is working well, and the benefit of reduced expenses will be seen in our future half-yearly accounts.

Proceeding to the expenditure, it may be observed that while most of the items have either been reduced or remain practically the same as last year, there are one or two increased amounts. The salaries show an increase of £903. This is accounted for by the engagement of additional clerks in the December half year, and circumstances fully explained to the meeting on the 27th of February last. Comparing this item with the December accounts, however, it will be found to show a reduction of £291. For printing, stationery, and advertising there is an increase of £48 in London and £202 at stations, which has been caused by the increased consumption of message forms and other stationery and by advertising in regard to the two shilling rate. On the whole, however, the expenditure has been less than the corresponding period of 1881. During the financial year just ended we paid 5 per cent. to the shareholders, and we added £9,500 to the reserve fund. But it is only by the aid of two months of the two shilling tariff that this result has been obtained. Therefore you see, gentlemen, that while it was all our desire to maintain the shilling tariff, it would not pay. That is the real business expression—it would not pay. When I had last the pleasure of addressing you it was to ask your approval of the working arrangement just referred to, namely, with the American Telegraph and Cable Company and with the Western Union Telegraph Company. These arrangements are now in force, and, as you are aware, the joint companies are now working under the two shilling tariff. So that at the present moment the companies have no less than eight cables across the Atlantic, and when these are in good working order and duplexed they would for all practical purposes be equal to double the number, so that comparing the carrying power of the cables with the traffic there is a large surplus carrying power equal to any growth of traffic that is likely to occur for a considerable period. Now, gentlemen, if we felt that we could employ the surplus carrying power at the shilling rate, we should never have reverted to the two-shilling, and after experiment, which was fairly and honestly attempted, we were obliged to make up our minds to resort to the more paying tariff. Had we not done this I should not have had the pleasure of submitting to you the dividend which I now recommend. Do not misunderstand me. I believe there will be a considerable growth in submarine telegraphy, but its rise is slow compared with the rise it has made during the last twelve years. So far as figures prove anything, it would have taken us, under the shilling rate, at least four or five years before we could secure the return which we now do under the two shilling rate. That would have involved a loss of one and a half to two millions sterling. Looking to the fact that your dividends have never been large, and to the enormous benefit which these telegraphs confer upon the commercial as well as political and social life of the world, I think it would have been asking too much of the shareholders of this company to give up for a term of years the dividend to which they were fairly entitled. In previous addresses to you at these half-yearly meetings I have given you much information, and placed before you many figures on the subject of telegraphy. On the last occasion I proved to you by figures that the shilling tariff was not sufficiently remunerative, even upon the reduced prices which telegraph property can be constructed to-day, because the feeling is that our stocks are watered; but if you take the cables now laid and working well, they could not be replaced by the amount of capital represented by the market value of the respective companies, not to speak of the large reserves held by some of them, so that that puts the question of working entirely aside. The value of a thing is what it will bring in the market, and the price in the market to-day with the shilling tariff would never give anything like the return upon the investment; but, notwithstanding all this, it must be a great field for enterprise, and the more uncertain it seems to me, the more mysterious, the more indefinite, and the more risky the operations are, they seem to be just the very thing which attract company promoters, and command more attention than those enterprises which are sound and more easily understood. For instance, we are now threatened with two additional cable companies in the Atlantic: one, the European and Canadian Company—I think it destroys itself by the fallacy of its own figures, and the letter addressed to the *Times* by Mr. Weaver, of the Anglo-American Company, proves this; and I think there is no harm in my calling public attention and the shareholders to the subject of their position. Their position is this: assuming that the two cables could obtain a full proportion, or 1-5th of the total of the traffic, assuming a traffic of 16 million words per annum, then they would have to carry 3,200,000, which, at 9d. per word, would yield £120,000, an amount which would fall far short of the remuneration for working expenses, reserve fund, and paids-out. If we take these figures, putting in the working expenses and paids-out at £48,000, and the renewal fund at £45,000—which, by the way, is not provided for in the prospectus set forth—there would be a loss of £5,000. It is necessary to draw attention to the statement that in this sum of £80,000 the paids-out and the amount of money paid away for land-lines transmission in the United States, Canada, and England, are calculated; reckoning the sum paid out at only 1s. 2d. a word, would amount to £20,000; but reckoning it at 3d. a word and this is what I should think could be the lowest average, it would absorb £4,000. There is no doubt as to their working resulting in a loss instead of profit at the price they profess to work it. There is no special provision made for cost of repair and interruption of cables, which is certain to occur. We know what these have cost this company, and what they cost all other similar enterprises; such repairs cost this company £90,000 during first year of its existence for repairing one cable only, and this is an item that this new company has entirely left out of their calculations. With regard to the proposed adoption of the mutual principle, let me suggest that it is possible that this system may resolve itself into a mutual subscription system, to make up the loss which would certainly fall on those who enter into mutual obligation and enterprise. Rumours of telegraph companies seem cropping up every day. Speculators, no doubt, have a great deal to do and say in these reports, because they are a very good handle for depressing and influencing the stock market. But for those who have placed their money in them for investment I would say, "Do not be frightened or run away at the reports circulated for interested purposes. If it does depress the stock, the low price will eventually strengthen those companies by bringing in a large number of bona fide investors, who will ultimately reap the advantage." It is my duty on an occasion like this to warn our own shareholders not to be alarmed, to rest satisfied that those who are watching over their affairs will take good care they are fully looked after

and shareholders will be well informed and advised whenever occasion renders it necessary. There is no question at all in my mind that the combination threatened by the Eastern Cable Companies and the Western Union Telegraph system of America will carry under any circumstances the bulk of the traffic, for the best of all reasons that they will be able, with an improved system at their command, to deal with their work more expeditiously than any new system could possibly do, and speedy telegraphy means time to the commercial man. Now, gentlemen, I hope you will excuse my making these remarks to you, because the submarine system is now become so very important that it has become for the world a necessity, and it would be a grave misfortune if for speculative purposes the property of a system so beneficial to the world should be discredited by men whose only object is to get a little money out of the contracts in the first instance. I trust telegraphy has a sounder basis, and those who have ventured into this particular class of property will have the satisfaction of knowing that it is now recognised property, and that the amount of good if not so large to themselves is likely to be in time so developed and matured as to make it a sound investment for them, and for the world it is really indispensable. With these remarks I beg to move that the report of the directors, dated July 19th, 1882, together with the statement of accounts to June 30th, be, and the same hereby is, adopted, and a final dividend of 5s. per share free of income-tax be declared, making with interim dividends a total dividend of 5 per cent. for the year ending June 30th, 1882.

Mr. Ford seconded the motion.

Mr. Jackson said that while he was glad that the company was so flourishing, and while cordially endorsing the chairman's remarks as to the value and efficiency of the telegraphic communication through the old companies, he thought it would be well in regard to the accounts to remove from the capital account the small balance in regard to the preliminary expenses. It was small and they had reduced it from time to time, but he thought it would be satisfactory to see it removed from the accounts altogether.

Mr. Newton said that since he had come into the room he had had a letter handed to him in regard to the new scheme circulated in the newspapers; he referred to Mr. Weaver's letter. He thought it should be circulated amongst all the shareholders. He believed that the scheme was simply to put money into the pockets of a gang of schemers, and it was no use mincing the matters. It was simply a combination of promoters of companies, and he was sure that existing shareholders would never benefit by the multiplication of telegraph companies. He was certain that they would have to battle with this difficulty sooner or later, and it was better, he thought, to take vigorous measures at once.

The Chairman: With regard to Mr. Jackson's remark he is perfectly right. But we have been writing off every year, and it was even discussed as to whether we might not write off a large sum at this time. But as we were placing a smaller sum to the reserve fund, and this last half-year embraced a considerable proportion of the shilling tariff, we thought it better not to be too severe on the shareholders, as we were desirous of maintaining the average interest at 5 per cent. As we have come back to the two shilling tariff we shall able, I think, be to put aside a larger sum than this shortly. As regards Mr. Newton's remarks, there is no doubt that Mr. Weaver's letter is one which must commend itself to all thoughtful men about this new company. As far as I can hear I think it has pretty well destroyed it; but still more destructive to their interests, I think, is their reply to Mr. Weaver. The weakness of the secretary's reply is so plain that any one who runs may read; and as to fighting them, they say, "Burnt bairns dread the fire." I am afraid the only way in which we can get rid of it is simply by people losing a little money by it, because it is as true as possible the companies which are now existing and which have got a certain amount of goodwill and position unfortunately stand at the present moment at 50 per cent. discount, and a new company cannot expect their stock to stand higher. I cannot conceive how they can get 20s. for an article not one half—not one fourth—as valuable as an article which can be bought in the market for 10s.; but they say that it takes ten years to bring up a crop of fools, and I think we are in that position now, and, so far as I can learn, there is very little chance of this new company ever getting beyond the paper of the prospectus which has been issued.

The resolution was then put to the meeting, and carried unanimously.

The Chairman then moved that Admiral Mayne be re-elected a director of the company.

Mr. Quilter seconded the motion, which was also carried unanimously.

The Chairman next moved that Mr. Charles Meara be likewise re-elected.

The motion was seconded by Mr. Ford, and carried.

Mr. Jackson moved that Mr. John G. Griffith and Mr. Joseph Sawyer, the retiring auditors, be re-elected.

Mr. Newton seconded the motion, which was likewise carried unanimously.

Mr. Griffiths and Mr. Sawyer briefly returned thanks for the honour done them.

Mr. Jackson said that it was usual, and he thought upon this occasion certainly more desirable than usual, after the trouble and time which the chairman had taken to get at the facts so lucidly laid before them, to propose a vote of thanks to the chairman and board of directors, and he had therefore much pleasure in doing so.

Mr. Hinton seconded the motion, which was put to the meeting and carried unanimously.

The Chairman in responding said: On behalf of my colleagues and myself I beg to thank you. I can only assure you that this is an enterprise—submarine telegraphy—that seems to be exceedingly attractive, and just as it is attractive it entails upon us greater trouble and greater responsibility, but it is a responsibility that we feel; and we are anxious to secure even a higher object than simply good dividends—that is, to secure for the public as well as the shareholders a thoroughly efficient and beneficial system of telegraphy. That object we have in view, and I think we have fairly proved it since we took up the management of this cable. We have fairly proved that such a system can be conducted in a way that will give satisfaction both to the shareholders and the general public. As you know, it is not a large dividend which we are paying, but we have been able to continue that dividend through very trying and troublesome times, and I am still hopeful that if we continue free from competition for a little time we should even add something to it. In the meantime we must husband our resources and take very great care as far as attention and watching closely all proceedings that appear to us to concern your interests. I should add that we have the most hearty co-operation from our friend Mr. Weaver, who with his wide experience has rendered very valuable and important aid to us. I think when such experience is brought to bear—when I compare such experience as this with the prospectus which has been presented to the public—I can only say that if there is any practical knowledge that will lead our enterprises to a successful issue, I think I can say that we are able to avail ourselves of it (hear, hear).

The proceedings then terminated.

THE SUBMARINE TELEGRAPH COMPANY.

The report presented at the meeting of the shareholders of this company for the six months ending June 30th, 1882, shows a balance of profit in favour of this company of £38,516 4s. 6d., which enabled the directors, after adding 10 per cent. of the gross receipts to the reserve fund, to recommend a dividend at the rate of 19 per cent. per annum, and carry over to the next account the sum of £123 16s. 9d.

The cost of repairs to cables during the half-year have been less than in the corresponding period of the year 1881, by the sum of £1,338 12s. 2d. All the cables belonging to and worked by the company are at the present moment in good order.

In accordance with the resolution passed at the meeting of the proprietors in February last, the directors have contributed on behalf of this company and the Société Carmichael et Cie., the sum of £200 to the fund being raised for the benefit of Mr. Jacob Brett, and charged this sum and a further amount of £740, which has been granted to the widows of three clerks, lately deceased, against the revenue of the half-year.

On Tuesday the half-yearly ordinary meeting of the abovenamed company was held at the offices of the company, 2, Throgmorton Avenue, Sir James Carmichael, Bart. (chairman of the company), presiding.

Mr. S. M. Clare, secretary, having read the notice convening the meeting,

The Chairman said: Now, gentlemen, the report and accounts having been circulated for some days, I suppose you will take them as read ("Take them as read"). I have often had the pleasure of moving the adoption of the report and accounts of this company, but I do not know that I ever did so with so great a feeling of difficulty in having nothing to say to you. I have not the smallest peg on which to hang a speech. Therefore my remarks will be very few and very concise. In looking over the report you will doubtless have observed that the repairs to our cables have been lighter during the last half-year than usual. In fact, we have been very fortunate in regard to our repairs to cables. By looking at the item of salaries you will see that there is an increase of £1,690 over the corresponding half-year in 1881. Now, this chiefly arises from the very large number of messages we have carried during that period, which amounts to 100,000 in excess of the number transmitted in the corresponding period of last year. This increase has necessitated our opening and establishing eight additional circuits with the Continent, and in consequence we have had to employ fourteen additional clerks. That will pretty well account for the increase you see in the amount of salaries. I think it will be pleasing to you all to know that on the 19th of June we transmitted the largest number of messages ever sent over our wires in one day; 10,867 were sent; and during that week 58,000 telegrams, containing 751,059 words were transmitted—the best week we have had in the history of the company. I congratulate you very much upon it, and I trust business will go on as during the past half-year. I am sure you will all lament the death of our old and valued colleague, Mr. Samuel Gurney, who was, with the exception of myself, the oldest director of this company, having been elected a director in 1858. I have now really nothing else to detain you for; I have told you a short story, and one which I hope you are pleased with. I beg now to move the adoption of the report and accounts.

Mr. Forde seconded the motion and said: I congratulate you on having all your cables in good order, and I hope they will be continued so.

The Chairman then put the motion, which was carried unanimously.

The Chairman then said: I beg to move that in accordance with the recommendation of the court of directors that a dividend at the rate of 19 per cent. per annum, less income-tax on capital, be declared and paid on and after September 1st next.

Mr. C. Smith seconded.

This resolution was also put and carried unanimously.

Mr. Forde then moved that Sir J. R. Carmichael, Bart., the Hon. Ashley Ponsonby, the two directors retiring by rotation, according to the deed of settlement, be re-elected. He need add no words of commendation.

The motion, having been seconded by Mr. Jowne was carried.

Mr. C. Smith proposed that the retiring auditors, Mr. Geo. Copeland-Capper, Mr. W. R. Cole, and Alderman Sir Thos. Dakin be re-elected. He remarked that the present state of the accounts testified so very much in their favour that there was no need to say anything further.

Mr. Harvie having seconded this motion, it was also carried unanimously.

The Chairman then proposed the election of Henry R. Brand, Esq., M.P., as a director, in the room of Samuel Gurney, Esq., deceased.

The motion was seconded by Mr. G. C. Capper, and carried.

Mr. Forde proposed a vote of thanks to the chairman and the directors, congratulating them on being able to put before the meeting such a satisfactory report on that occasion.

This was seconded by Mr. Jowne, and the chairman having very briefly replied, the proceedings terminated.

UNITED TELEPHONE COMPANY (LIMITED).

The report states as follows: A reference to the capital account will show that up to 30th April, 1882, the sum of £55,966 13s. 8d. has been expended upon the works in connection with the London and Provincial Exchanges and the Stock of Instruments, being £21,739 9s. more than the outlay shown in the last balance sheet. The revenue account shows that the receipts of the company from all sources properly attributable to the year have been £42,624 15s. 3d., as against £20,644 10s. 6d. in the preceding year, or an increase of £21,980 4s. 9d. The working expenses of the year have been £21,050 4s. 3d., as againt £20,273 12s. 11d. for the preceding year, or an increase of £776 11s. 4d. The balance of net revenue is £21,945 8s. 7d., and the directors recommend the distribution of a dividend of 5 per cent. for the year, leaving a balance of £1,945 8s. 7d. to be carried forward. Subject to the approval of the proprietors, it is intended that this dividend shall be payable on the 2nd August. The above figures of themselves illustrate the progress of the business. It will be observed that whilst the working expenses have but slightly increased, the receipts have more than doubled; and the board feel that, considering the short time the company has been in existence and the many difficulties that have had to be overcome in creating and meeting a new public want, the result may be regarded as very satisfactory. As an evidence of the progress of the business it may be stated, that the numbers of subscribers to the London exchanges of the company has increased from 914 on the 30th April, 1881, to 1,673 on the 30th April, 1882. Since that date a large additional number (which is growing from day to day), have been secured. The private line business has increased from 186 lines to 366 during the year. Considering that the public are only beginning to realise the great convenience and saving of time and expense consequent upon the use of the Telephonic Exchange system, and having regard to the practical difficulty attending the erection of the necessary machinery for the efficient performance of the service, the board hope that these results will be appreciated by the proprietors. The board are happy to be able to say that they are working in harmony with the Post-office, and they feel assured that as every day must manifest, more and more clearly, how admirable and indispensable an adjunct to the work of the Post-office the telephone is, the relations with that Department will extend and become closer. The recent declaration of the Postmaster-General that the Post-office do not favour a monopoly of telephonic communication either for themselves or others is so far satisfactory, that it will enable the Department to grant the company licences for many important towns and districts from which they have hitherto been excluded pending that decision. As to the policy itself it will no doubt satisfy an abstract principle, but if widely applied it can only lead to embarrassment and serious limitation in the use and value of telephonic exchanges, which depend upon the possibility of placing the whole of the subscribers in any town or district in communication with each other. This great object will be seriously impeded by the multiplication of competitive companies (assuming any of them to possess the means of competition without infringing the rights of this company), each having a number of subscribers cut off from the subscribers of the other. The board have from time to time during the year notified to the proprietors the result of the several proceedings forced upon them for the protection of their rights. It is, therefore, not necessary to say more on the subject, than that in the Scotch case the company's position as exclusive owners of all the essential patents was explicitly and fully confirmed; whilst in the English case the validity of the Bell patents was entirely established, and the validity of the other patents practically so, the judgment being entirely in favour of the company as regards the transmitters, and only failing by reason of a purely technical point not affecting the real question. The board have taken all necessary measures both by appeal and disclaimer to remedy the failure, and they are advised that their claim to possess the only possible, as well as the best telephonic instrument, must shortly be finally established. The board, following the policy already adcpted of making over to persons locally interested the management of the telephone business within the limits of particular districts, conditionally upon the formation of district companies affiliated to the parent company, have to ask the shareholders to confirm the agreements in relation to the "Telephone Company of Ireland, Limited," and the "Western Counties and South Wales Telephone Company, Limited." The general basis of the agreements under which the business is transferred is the repayment to the United Company of all sums expended by them in the districts up to the date of the transfer of the business, one-half of the ordinary capital of the district companies, and the further payment of annual royalties upon the telephones used. Negotiations are also pending for the creation of other subsidiary district companies.

On Tuesday, at noon, the second annual ordinary general meeting of the abovenamed company was held at Cannon Street Hotel, James Brand, Esq. (chairman of the company), presiding.

The notice convening the meeting having been read by the Secretary, Mr. Blaikie,

The Chairman said: Gentlemen, we have first to submit to you the report and accounts for the year ending 30th April, 1882. You have all read them and looked into the accounts, I have no doubt, and therefore I suppose you will take them as read; and it will be for me now to make a few remarks, and I will make them as few as possible, on the subject of the report and accounts. As I am not very good at making speeches I have written out what I have to say, which will occupy your time less than if I were to fumble away at a speech (laughter). As to the report and accounts I think we have made them so clear that they will require very little explanation from me, and will leave not a great deal for me to say; but I think I may fairly congratulate you on the progress we have made, and considering the large additions made to our system and the amount of work we have done, I think our capital expenditure has not been excessive. We may, at any rate, congratulate ourselves that the work for which you have paid has been good work, for notwithstanding the sinister prognostications which, I dare say all of you remember although a year and a half ago, when we were in much trouble, were made by some of those who were connected with us in the early part of our undertaking, who said that not only was our work bad, but that it would be a source of fatal mischief to the populace, and that your chairman and directors would in consequence run the risk of indictment for manslaughter. I am glad to tell you we have not had one single accident with our wires, and our works have stood the test of very heavy wind storms, perhaps the heaviest during the lifetime of any of us. That is a fair subject of congratulation. You will notice that our revenue has increased up to April 30th by nearly double; since then we have had a further very large increase of fresh subscribers coming in very fast. Our working expenses, no doubt, are heavy. They show a very small increase on last year, and notwithstanding the large increase of business our indefatigable managing director, Mr. Morgan, uses every effort to keep them down; and no doubt as we get more and more knowledge of the working of our peculiar business, and avail ourselves, as we do, of every new invention that we find out to be an improvement, we shall succeed in reducing our expenditure under this head, and we fully believe that its proportion to our income will become less and less every year. As to our modest dividend, I can say we have earned it. We could, of course, with your permission, have followed the same course we did last year and realised a part of our shares in one of our subsidiary comp anies, so as to make a good division in the shape of bonus. But we have considered the course we are pursuing is the best for your interests; we divide what we have fairly earned, and for the present are leaving our shares in our subsidiary companies to stand as a means of helping to earn our dividend and as a substantial reserve fund in addition to the large sum we wrote off last year against renewals, depreciation of plant, and all the troubles our business is heir to. I come now to our relations with the Post-office, which is the most important part of our business, and to the satisfactory carrying out of it. I think our report is pretty clear on that point. We are using every effort to satisfy the Postmaster-General, as well as the public, that we are able and willing to perform the services and duties we have undertaken. I believe we have given him, so far, such satisfaction that he sees no need to exercise the right reserved to him of stepping in, if necessary, and doing our work himself. We intend to make our service much more perfect. Perhaps some of you will say there is much need for that; but if you knew the difficulties with which we have to contend, you would be very lenient, I am sure. I may say on this point that if you have any complaints to make, if you will write to Mr. Morgan, our managing director, or to me, I will take the trouble to attend to it personally. We are now endeavouring to make great extensions in our work, and we hope very soon to extend the blessings of the telephone to various seaside places. I do hope that soon almost every town in Britain will be in communication with London, and I do not think it will be very long. We are getting on very well with the subscribers in Britain, and I have no doubt that business men will soon be enabled to get holidays by using the telephone, and so communicating with London. But all this involves enormous time and labour, especially in the matter of wayleaves—and that is a very difficult point—a point which, as we have to go long distances and use railways, we could scarcely overcome except with the cordial co-operation of the postal authorities. You will doubtless have seen Mr. Fawcett's statement that he did not consider he could continue to grant anything in the shape of a monoply to any one telephone company. The monoply we did enjoy, if it could be called a monoply, was one of the very mildest kind, and, as I before stated, the Postmaster-General reserved to himself the right of taking our business over and doing our work himself, if we could not perform it, and I think it was more of a matter of carrying out his free trade principles, or something of that kind, that induced him to alter his previous decision, which I venture to say was the just decision, that this company, being the progenitor of the telephone work, and because the telephone business is a very difficult one to carry out, I think he made a just decision in confirming the work to be done by companies. However, as to this matter, one company alone has been able to carry out satisfactory telephone work. I am bound to say, because I believe it to be entirely true, that it cannot be satisfactorily carried out in any one town or district by more than one company or system, for independently of the trouble and difficulty created by rival candidates for subscribers and way-leaves, the benefit of the telephone would be partially destroyed, by the fact that the subscribers to one system would be cut off from communication with the subscribers to another. We have taken every pains and gone to considerable expense to ascertain the facts, and we find that since the telephone was invented in America and Europe, wherever it has been attempted to introduce two or more systems in one place, dire confusion results, and in the end, parties have been forced, either of their own accord or by the action of Government, to fuse their systems and use identical instruments. However, it has been thought fit to announce that a licence will be given to certain persons if they show themselves worthy of it and responsible; and if any persons do obtain a licence, they will first have to obtain proper instruments to carry out the business, which I think at this moment is rather a doubtful enterprise on their part. Then they will have to get subscribers; and then will commence all the real troubles of their undertaking; troubles we have undergone and are undergoing, but have successfully got over

to a very great extent. All I can say is we are not afraid of competition. We shall continue as we have done all along, honestly to develop our very great and interesting enterprise. As to our patents, which one way and another have cost us much money and anxiety and law, we have at last, I hope and think, put them on a satisfactory basis. We have from time to time fully informed you by letter of our progress in the law-suits that have been forced upon us. In Scotland we have been entirely successful, and Lord M'Laren upheld the validity of our patents to the fullest extent. The appeals which have been lodged against his decision have been withdrawn. In this country the technical objections which to Mr. Justice Fry seemed fatal to our Edison patent for a short time, were, you will be glad to hear, overcome by disclaimer on Saturday last (hear, hear). I will read you on this subject what Messrs. Waterhouse and Winterbotham say. This letter was written last night:—

"Dear Sir,—You will like to be able to report to the shareholders at the annual meeting to-morrow the present position of matters with regard to the company's patents. We may assume that they are acquainted with the contents of the circular letter of the 24th of May last in which the successful issue of the proceedings in Scotland were reported, and also the result of the more recent litigation in this country before Mr. Justice Fry, resulting in a judgment for the company on the Bell patent, but in an adverse decision on the Edison patent upon a technical question relating to the phonograph. In substance his Lordship's decision amounted to this, that Mr. Edison's claim for what is known as the carbon transmitter was a good claim and covered the instrument used by the defendants, but that Mr. Edison having included in the same patent a claim for the phonograph (which claim could not be sustained in consequence of an insufficient description of that invention in the provisional specification) the whole patent was vitiated. As the result of a very careful consideration of the question by counsel immediately after the decision of Mr. Justice Fry, it was thought well to apply at once for leave to disclaim the phonograph without waiting for the decision of the Court of Appeal on the question whether Mr. Justice Fry was right in his decision on this point or no. The case could not have been brought before the Court of Appeal until the end of the year, and although the counsel advised that the appeal would probably result in the company's favour, this was necessarily only an opinion, while a disclaimer would be decided more promptly and if obtained would dispose once and for all of the objection. The necessary application for a disclaimer was accordingly made, and we are glad to be able to report that the Attorney-General, on Saturday last, after carefully considering the whole case, granted the leave asked, and the necessary disclaimer will be forthwith filed. The only objection upon which the defendants were successful being thus disposed of Mr. Justice Fry's decision upon the patent as it now stands is on every point in favour of the company. We think therefore that you may now congratulate the company upon having two patents which have stood the most searching and hostile criticism which the ingenuity of the legal and scientific mind can bring to bear upon them, and although it is of course possible that the great value attaching to these patents may induce some adventurous persons to carry the litigation to a higher court (if they can induce the public to find the money for the purpose) we have every confidence that they will fail in reversing the decisions which have already been given. We are, dear Sir, yours faithfully,

"WATERHOUSE & WINTERBOTHAM."

I think that announcement is a very gratifying thing to all of us. To show you a little more how the decision will act, we telephoned Messrs. Waterhouse and Winterbotham, and they say that some of our opponents have been attempting to get up a company to do this business, and they said that they had Hunnings' transmitter to use in conducting the business. This transmitter we were advised of as being a childish infringement upon our Edison patent. When we lost the action to a certain extent, of course this Hunnings' transmitter was open to the public for a time, and these gentlemen immediately seized the opportunity to manufacture an enormous quantity of them, so that whether he won or lost eventually they would be able with the proceeds of the articles they took from us,—to use a mild term,—to enter into competition with us. But, however they may have benefited, our disclaimer of Saturday protects us. As to the *bona fides* of the contract, this will be referred to the Attorney-General, and, no doubt, upon such a question he will give a fair decision, as satisfactory as possible to both parties. I do not know whether you expect me to say a word as to what is the value of our business, and so forth. Of course I have no wish to induce any one to invest in telephone securities, but to our shareholders I would say, under no circumstances should you be in a hurry to part with your property, and although we have only as yet been able to pay a small dividend, you must not forget that our enterprise still is a very new one. We have overcome Government difficulties, and I am certain that we are on the eve of overcoming much greater difficulties. We may yet meet with, of course, opposition and trouble of every kind. In our progress through life we are entitled to expect that, but I do not waver from the constant belief I have always entertained that the United Telephone Company will triumph. As it has hitherto done over the obstacles in the past, so we shall triumph over the obstacles in the future; and there is no kind of doubt that against any kind of opposition or competition from any and every source we shall continue to carry on business, as we have done, with our utmost efforts and our greatest anxiety for the interests of the shareholders that have been confided to us, and I am certain we shall prosper and triumph and prevail in the end. I do not think that I have anything more to say, but I have to move that the report be taken as read and received and adopted. Of course, if any gentleman wants to ask any questions at all about anything connected with the business, all of us shall be only too happy to afford the fullest information in our power.

Joseph Forbes, Esq., seconded the motion.

Mr. Galsworthy said that the report must appear almost too satisfactory. The revenue for the year had been £42,624, against £20,644 for the previous year, or more than double; whereas the expenses, although heavy, had only increased by £766. If they went on like that they ought to have a very good dividend next year. The number of subscribers had increased from 914 to 1,673, which seemed a capital index of prosperity, as it meant the doubling of the business in twelve months. It appeared too that it was a practical impossibility for them to have any competition. Just let them imagine a dozen telephone companies in London! If they were brought out he had no doubt that the public would take shares; but what a state of confusion would result if there were a dozen sets of subscribers none of whom were able to communicate with any of the others. He believed entirely in the policy which the directors were carrying out—that of keeping the dividend down to a moderate sum. Those of them who held shares as an investment did not want to run the shares up in the market; they hoped, indeed, for a larger dividend next year; but their first business was to put the company on a permanent and stable basis as a business concern.

A shareholder asked what was the increase of subscribers since the date to which the report was made up?

The Chairman said that he was glad to say that since April 30th, to which date the report supplied the figures, the number of subscribers had increased from 1,673 to 1,924 (hear, hear), and they were running their wires twice as quick as they used to do. Mr. Morgan being at it all day long had found out a way of working that was far better than the old one. With regard to the increase of expenditure over last year he might say that they had satisfied themselves that their income would steadily increase, and, with their management, the expenditure would not, he thought, show any very large increase. He would ask Mr. Morgan to read a summary of the work they did during the past three months for the satisfaction of the shareholders.

Mr. Morgan read a tabular statement which showed the orders received in the first three months of 1880 to have been 90; in 1881, 238, and in 1882, 319. Lines opened:—In first three months of 1880, 75; in 1881, 196; in 1882, 395. Average calls per subscriber:—In 1880, 4·28; in 1881, 5·16; in 1882, 6·88. Total calls during the year 1880, 943,831; in 1881, 2,313,000; at the present time close upon 4,000,000. Subscribers on 30th April, 1881, 914; on 30th April, 1882, 1,673; present time, 1,924. The rate of opening the wires had averaged 100 a month since last October. During June last 130 wires were opened. The number of exchanges in 1880 was 7; four more were opened in 1881, three more in 1882, and during the last three months an additional exchange had been opened at Smithfield, making a total number of 15.

The Chairman: The first resolution is that the report of the directors for the year ending April 30th, 1882, be taken as read, received, and adopted.

James Staats Forbes, Esq., seconded the motion, which was carried unanimously.

The Chairman: The second resolution is that a dividend of 5 per cent., less income-tax, on the paid-up capital for the year ending April 30th last, be now declared.

Mr. Forbes seconded the motion.

Mr. Galsworthy said that it was very inconvenient to pay income-tax on the dividend, and he thought it would be better to declare it free of income-tax.

The Chairman said that they had taken their usual course, but they would remember the suggestion next year.

The resolution was then put to the meeting and carried unanimously.

The Chairman: Resolution 3 is that Messrs. John W. Batten, Joseph B. Morgan, and Col. Gourand, who retire from the Board by rotation, be re-elected.

Mr. Forbes seconded the motion, but suggested that the names should be put to the meeting individually.

This was accordingly done, and the three gentlemen were unanimously re-elected.

Mr. Garrett asked if there was any objection to having half-yearly meetings?

The Chairman: Personally I have the very greatest objection to half-yearly meetings, because I have to make speeches, and that is a dreadful task (laughter). Don't you think a circular every half year would answer the purpose? We will consider it, of course. If the question is one of having an interim dividend it may be a course to be adopted.

Mr. Agnew, M.P., then moved that the auditors, Messrs. Quilter, Ball & Co., and Messrs. Price, Waterhouse & Co., be re-elected at a remuneration of fifty guineas each per annum.

Mr. Galsworthy seconded the motion.

Mr. Garrett asked if it was necessary to have two professional auditors in a company of this kind?

The Chairman said that that was a matter which rested entirely with the shareholders.

Mr. Garrett said that it was solely a question of keeping the expenses down.

Mr. Agnew thought that if they employed one auditor only they would probably have to pay him 100 guineas; the existence of two auditors was an additional security.

The resolution was then put to the meeting and carried unanimously.

The Chairman: The next resolution is that this meeting confirms (subject to such modifications as the directors may think fit to make) the agreements with Mr. Arthur Dudgeon and with Mr. George Hunter Robertson, dated respectively the 22nd March, 1882, and the 31st March, 1882, for granting in the first case to a company formed under the name of "The Telephone Company of Ireland (Limited)," and in the second case to a company intended to be formed under the name of "The Western Counties and South Wales Telephone Company, Limited," exclusive licences for the use of the company's patents in certain districts, partly in consideration of full-

paid-up shares in such respective companies and partly in consideration of royalties, and in connection with such licences to sell for fully paid shares and cash any business now carried on by the company within the districts comprised in such licences respectively and any property used in such business. These are two more companies formed upon the basis of the Lancashire Telephone Company and the National Telephone Company, which are going on, I think I may say, in a fairly satisfactory way, and which I hope will be of even more value to us than they are now. The capital of the Irish Company is £200,000, £25,000 being in preference shares of £10 each, and £175,000 in ordinary shares of £1 each, of which the United Telephone Company receives £87,500 in shares. The amount to be repaid to us in cash for the expenditure already incurred in Dublin and elsewhere in forming the nucleus of this business, now selling, is about £5,500. As to the Western Counties Company we propose a capital of £275,000, of which £25,000 is in preference shares of £5 each, and £250,000 in ordinary shares of £1 each, of which the United Company receives £125,000, and the amount to be repaid in cash for the expenditure is about £6,000. I think it is necessary for you to pass these resolutions in order to enable us to get these companies floated.

Mr. Galsworthy asked if the Western Counties Company was yet founded?

The Chairman said that it was as good as founded. But for some little hitch it would have been completed before this time.

A shareholder would like to ask a question, but would not press it if it was in any way inconvenient to the board to answer it. What hold had they got in the provinces at present, how many subscribers had they there, what towns they served, and whether they were sufficiently strong in those towns to hold their own against any rivals, as he understood they could do in London?

The Chairman said he could not go into these details, because they did not properly belong to them. The property in the provinces belonged to the Lancashire and Cheshire Company, the National Company, and the Northern Company. He thought they were fairly strong in all the towns they had the licence for. They had not yet succeeded in getting licences for all the places they should like, but the new decision of the Postmaster-General would enable them to have licences for every place not licenced. The Chairman of the National Company, who was present, could doubtless give the fullest information on the subject.

Mr. Forbes then seconded the resolution.

In reply to a question by Mr. Galsworthy as to the disposal of the South Western Counties Company's stock, the Chairman said that they got one-half (£125,000) of the issue: the local company distributed the other half to people useful in forming the company, to men who were owners of collieries and tin works and so forth, who would be likely to employ the telephone.

Mr. Agnew, M.P., said that the chairman had stated that he had not the gift of making a speech. He had heard from time to time oratorical speeches from the chair, yet he was glad to say that he had never heard a better speech than that read at this meeting. The chairman and his colleagues had manned the ship and piloted it through the troubled waters, and he thought the shareholders must agree with him that they were somewhere near the promised land at last. He was sure that the chairman and the other members of the board had given to this enterprise time and energy to the disadvantage, he believed, in many cases of their own personal affairs, and he thought that the shareholders were greatly indebted to them for the patient labour and care which they had devoted to the interests of the company. He begged to propose that their thanks be given to the chairman and the members of the board for their attention to the shareholders' interests, and for the position which their report upon this occasion showed that the company occupied.

Mr. Forbes would second that part of Mr. Agnew's motion referring to the chairman. He did that as a shareholder, first, to be within his right, and in the second place, because from his association with the chairman from the very inception of that business he was perhaps a better judge, and one more entitled from personal knowledge of his qualities than perhaps any outsider living. Their chairman had that characteristic of all strong and big men—exceeding modesty (laughter). He stated that he could not make a speech, yet they saw that he could. He could say of him that a more earnest, courageous, honourable man did not exist in the City of London; and he had besides that great quality without which no great enterprise was ever pulled through, however ably it might be conceived—pluck and entire faith in what he was about. He had no hesitation in saying that but for the possession by him of these qualities in more than an ordinary degree, this company would not have been in so good a position as it was in to-day. If it had lived through early divisions and great discouragements, that was owing a great deal more than he could describe to the qualities of their excellent chairman. Therefore he felt privileged in being allowed, as far as the chairman was concerned, to second the motion before the meeting.

Mr. Galsworthy said that nothing was more difficult to manage than a telephone company. Directors were overwhelmed with details and practical difficulties of all kinds, therefore all the more credit was due to the chairman of the board for the good position which the company now occupied. He was very glad indeed to see that their friend Mr. Batten was re-elected, because there was enough law in his head to pull them right through any of their difficulties. Whether they looked at the board as a whole or as individuals they must feel great confidence in their skill and ability.

A shareholder asked under what item the law expenses for the year were included.

The Chairman said that the legal expenses were included under two heads in the accounts—£4,702, and the remainder shown in the balance sheet as £350. There were no other legal expenses save those connected with defending their patents.

Mr. Joseph Dodds, M.P., said that he did not understand that the resolution [illegible] nded except in so far as the chairman was personally concerned. He had much pleasure in supplying that defect before putting the resolution to the meeting. With regard to the speech of the chairman, he could say, like his friend near him, that though he had attended a great many meetings of shareholders and public meetings of various kinds, he never, in the whole course of his experience, heard a more comprehensive, clear, business-like statement than that put before them by the chairman. He had much pleasure in seconding the motion, and a vote of thanks to the directors generally.

The motion was then put to the meeting and carried unanimously.

The Chairman said that, on behalf of his colleagues and himself, he had to thank them very much. They could certainly take to themselves the praise that they had endeavoured to do their best, and he could assure the meeting that they would endeavour to do their best for the future. They wished to do all that was possible, and if they had failed in any way it was because they had not the ability, not because they had not the will (hear, hear).

The proceedings then terminated.

Settling Day and Quotation.—For these application has been made to the Stock Exchange Committee, in the case of the South African Brush Electric Light and Power Company (Limited). Shares.

Quotation has been granted to the Brush Electric Light and Power Company of Scotland (Limited).

W. T. Henley's Electric Light and Power Company.—A call of 10s. became due on the shares of this company on the 1st. inst.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Aug. 2.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	17 - 18	[illegible]
		Do. Do.	10	36 - 40	[illegible]
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	[illegible]	[illegible]
150,000	1	Electric Light and Power Generator Co.	1	[illegible]	[illegible]
25,000	5	Great Western Electric Light & Power Co.	2½	[illegible]	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	7 - 8	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	[illegible]	
40,000	5	Pilsen, Joel & General Electric Light Co.	2	[illegible] - 2	
		TELEGRAPHS.			
2,116,400l.	Stk.	Anglo-American, Limited	100	49 - 50	
2,441,800l.	Stk.	Do. Preferred } Def'd. receiving no div until	100	79 - 80	[illegible]
2,441,800l.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19 - 20	[illegible]
130,000	10	Brazilian Submarine, Limited	10	[illegible]	
16,000	10	Cuba, Limited	10	[illegible]	
6,000	10	Do. 10 per cent. Preference	10	[illegible]	
13,000	10	Direct Spanish, Limited	9	6 - [illegible]	
6,000	10	Do. 10 per cent. Preference	10	[illegible]	
65,000	20	Direct United States Cable, Limited, 1877	20	[illegible] - 12	[illegible]
100,000l.	100	Do. 6 per cent. Debenture, repayable 1884	100	101 - 104	[illegible]
380,000	10	Eastern, Limited	10	[illegible]	[illegible] xd.
70,000	10	Do. 6 per cent. Preference	10	[illegible] - 13	
232,000l.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 - 102	
200,000l.	100	Do. 5 do. do. Aug. 1887	100	100 - 103	[illegible] xd.
200,000l.	100	Do. 5 do. do. Aug. 1899	100	100 - 105	xd.
199,750	10	Eastern Extension, Australasia & China, Limited	10	[illegible]	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	104 - 107	xd.
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 - 105	
140,000	100	Do. do. registered, repayable 1900	100	102 - 105	
100,000l.	100	Do. 5 per cent. Debenture, 1890	100	102 - 105	
254,300l.	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 - 104	103
345,700l.	100	Do. do. do. To Bearer	100	101 - 104	103
22,050	10	German Union Telegraph and Trust, Limited	10	[illegible]	
163,390	10	Globe Telegraph and Trust, Limited	10	[illegible]	[illegible] xd
163,209	10	Do. 6 per cent. Preference	10	[illegible]	[illegible]
125,000	10	Great Northern	10	[illegible]	
100,000l.	100	Do. 5 per cent. Debentures	100	100 - 103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	25 - 26	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 - 105	
17,000	25	Indo-European, Limited	25	[illegible]	
38,148	10	London Platino-Brazilian, Limited	10	[illegible] - 5	
12,000	10	Mediterranean Extension, Limited	10	2 - [illegible]	
8,200	10	Do. 8 per cent. Preference	10	[illegible] - 9	
9,000	8	Reuter's, Limited	8	[illegible]	
280,000	Stk.	Submarine	100	265 - 275	
58,225	1	Do. Scrip	1	[illegible]	
4,200	Cert.	Submarine Cables Trust	100	..	
37,350	12	Telegraph Construction and Maintenance	12	28 - 29	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 - 104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	[illegible]	
30,000	10	West Coast of America, Limited	10	[illegible]	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	[illegible]	
200,000l.	100	Do. 6 per cent. Debentures "A" 1910	100	104 - 107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 - 100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 - 128	
1,030,000l.	100	Do. 6 per cent. Sterling Bonds	100	103 - 106	
88,321	10	West India and Panama, Limited	10	[illegible]	[illegible]
34,563	10	Do. 6 per cent. 1st Preference	10	[illegible]	
4,669	10	Do. 6 do. 2nd do.	10	[illegible] - 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	[illegible]	[illegible]
200,000	1	Oriental Telephone Co., Nos. 100 000 to 300,000	[illegible]	[illegible]	
100,000	5	United Telephone Co.	5	[illegible]	[illegible]

TRAFFIC RECEIPTS.

Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending July 14th. 1882 were £1,828, after deducting the "fifth" of the gross receipts payable to the London, Platino-Brazilian Telegraph Company (Limited).

West Coast of America Telegraph Company (Limited). The gross earnings traffics and steamer, for the first half of July are £1,825, against £1,675 in the corresponding period last year.

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 15th July are £2,521, as compared with £2,135 in the corresponding period of 1881. The March receipts, estimated at £7,345, realised £7,4[illegible]. For the half-month ended the 31st July are £2,400, as compared with £2,017, in the corresponding period of 18 . The April receipts, estimated at £6,858, realised £6,990.

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ELECTRICAL ENGINEERING.

Only a few years since young men desirous of entering the electrical profession were limited to the single branch of telegraphy, and their choice necessarily lay between becoming practical operators, skilled electricians, or manufacturers of electrical apparatus and appliances. The first-mentioned class, of course, is composed of a large body of generally intelligent men; for, wherever a telegraph line, whether overhead or submarine, exists, there must also be the operator. The skilled electricians and manufacturers are, however, comparatively few, and for some time past the former certainly have had little chance of improving their positions, simply because until recently no other branch of electrical science was open to them. During the last six years or so, such progress has been made in other ways than telegraphy of pressing electricity into our service that no person with only a moderate knowledge even of this fascinating pursuit should be unable to keep himself well employed. To young electricians of eight or ten years ago it was the height of ambition to be connected with submarine telegraphy, either in the service of the cable manufacturers or in that of some telegraph company. The work of testing cables, although somewhat monotonous, is of a more scientific, and therefore of a more interesting, character than any other branch of telegraphy. Their manufacture, too, is a subject for particular study, and a good knowledge of machinery may be gained in a cable factory. Then, perhaps, the best part of all, the life on board ship when the cable leaves the manufactory, the laying, and the homeward voyage—all this was calculated to centre the thoughts of young men engaged in electrical work, upon submarine telegraphy. The bright side of a submarine telegraph engineer's life is a very fair one, but the reverse must not be forgotten. The junior or assistant electricians should always remember that there are many slack periods in cable operations, and it is then often necessary that the *personnel* of the staff should be reduced. When such a proceeding as this took place at the period we are speaking of, it was sometimes a very difficult matter for the young electrician to find other employment. We think, however, that this is a contingency not to be feared in the present day.

We have now several branches of electrical engineering other than the telegraph, one of which at least (telephony) will become as important. What with this, electric lighting, electric railways, &c., the present difficulty is to find men competent to perform the work they are called upon to do. To prove this we have only to quote the remarks of Mr. W. H. Preece, F.R.S., who examined the candidates in telegraphy at the recent examination of the City and Guilds of London Institute.

The examiner says :—

The papers of the competitors in the first class of the Honours examination are of very fair merit. The replies given in the Ordinary, or Pass, examination are not altogether of a satisfactory character, except in one or two cases. The competitors who have taken but a low place in the second class, and those who have not passed, have, in many cases, shown that the knowledge they possess of the subjects they deal with is of a mere mechanical nature, and has simply been attained from constant practice at a particular system with which they have had to deal, and they appear to have but little notion of the broad principles upon which that particular system is founded; thus, for instance, they describe at full length, and quite correctly, the methods of making tests with particular forms of apparatus, but it is quite evident that if these tests had to be made with instruments which were slightly different in character to those described the experimenter would be unable to carry them out. In one or two instances the answers given have been merely definitions, such as would be found in any technical dictionary.

Altogether, I think the character of the papers submitted is superior to those of former years.

Again in the same examinations on electric lighting, Professor W. E. Ayrton, F.R.S., says :—

The answers to the questions set at the recent Technological Examinations in Electric Lighting and Transmission of Power show that the candidates, with a few striking exceptions, have hardly advanced beyond the mere descriptions of the construction of machines, and have had little opportunity of studying the science underlying their trade. Considering, however, how very difficult it is for students to find men who are competent, and who at the same time have sufficient leisure to teach, the answers in this subject may be regarded as fairly good.

Although these reports are not particularly favourable we trust that the students who sat at these examinations will not be discouraged with the results of their labours, but rather turn again more earnestly than ever to their studies with the assurance that a fair knowledge of electrical science should procure for them good and profitable employment. We do not know what questions were given, either in telegraphy or in electric lighting, for the purposes of the examination we have referred to, but there is usually a tendency on the part of examiners to find out, not what the students know, but rather what they do not know; or, in other words, the questions are generally set in such a way as to impress one with the profound knowledge of the examiner himself, but not so as to bring out the students' acquaintance with the every-day work he is likely to be engaged in. Enough has been shown, however, to prove that our supply of competent electricians for our most recent industries is very small, and we cannot imagine a brighter prospect for young men desirous of acquiring a profession than that of electrical engineering.

Professor Ayrton's remarks as to the difficulty of finding competent teachers is true enough so far as institute or college teaching is concerned, and therefore the youthful aspirant's best method of gaining the necessary knowledge will be to apply for a pupilage with a firm of electrical engineers or in a company. This is generally the way in which a youth is introduced into the profession of a civil engineer, and if he chooses to supplement his daily practice by private lessons, or in the classes attached to an institute like that of the City and Guilds of London, so much the better for his chances of advancement. We are still only at the commencement of the work to be done in electric lighting; electric railways, beyond an experimental trial or so, have as yet only been talked of; and the telephone industry, which should rival, if not surpass, that of the telegraph, has up to the present been crippled for reasons not necessary to refer to here. Electrical engineering may, therefore, assume at any moment an importance of such magnitude that we shall fail to take full advantages of the opportunities offered simply because we are not prepared to deal with the work put before

us. Let those men already possessed of a competent knowledge of electrical matters be ready to seize upon the first opportunity of entering the sphere of the more recent discoveries and thus gain for themselves positions they might wait for in vain in the established branches of electrical science.

ON THE ELECTROMOTIVE FORCE OF A ZINC-CARBON ELEMENT.

By M. BERTHELOT.

I HAVE measured, by the aid of a Mascart's electrometer, the electromotive force of a zinc-carbon element immersed in dilute sulphuric acid.

This force varies very rapidly by reason of polarisation, and the chemical effects which it is able to set up vary exactly in the same proportion.

When the circuit is closed the electromotive force of a zinc-carbon element much surpasses that of a zinc-platinum element, the proportion being as 1·76 : 1. It also surpasses that of a Daniell element in the proportion of 1·29 : 1—that is, it is approximately equal to the sum of the forces of a Daniell and of a zinc-cadmium element combined. At the moment when the two poles of the zinc-carbon element are connected its electromotive force surpasses even this sum, and the ratio of the said force to that of a Daniell may be as 1 : 1·37, but the force falls immediately to 1·30 or 1·29. It has then about double the force of a zinc-platinum element—*i.e.*, two zinc-carbon elements are more powerful than three zinc-platinum elements all alike plunged in dilute sulphuric acid.

But this force does not remain long at its initial value; it is sufficient to maintain the circuit closed for a few minutes by means of a copper wire of a diameter of about $\frac{2}{3}$ millimetre and 0·20 metre in length, to see the electromotive force of a zinc-carbon become equal to that of a Daniell (0·995 : 1). At this moment two zinc-carbons are surpassed by three zinc-platinums. After the circuit has been closed for some hours a zinc-carbon falls below a Daniell, the ratio being 0·83, and the electromotive force is very near that of a zinc-platinum. Lastly, after the circuit has been closed for thirty-six hours one Daniell may even surpass two zinc-carbons, at least in the first moments which follow the opening of the circuit and the connection of the two poles with the electrometer.

If I make this reservation it is because the electromotive force, which has fallen to the lowest point while the circuit is closed, tends to increase little by little when it is re-opened. The electrometer shows very distinctly these variations. Thus, after the circuit has been closed for some minutes, the electromotive force of a zinc-carbon, compared after opening to that of a Daniell in the electrometer, has been found 0·67, in a few moments 0·74, then 0·83, and, finally, 0·98, which value is approximately stationary. In the same manner, after the circuit has been closed for some hours, I have found 0·52, then 0·63, and then 0·76, a value almost stationary and answering to that of a zinc-platinum element.

It is sufficient to take the battery to pieces and steep the carbon and the porous vessels in pure water, renewed several times, for some hours in order to restore the original electromotive force. This may be done several times in succession, and, without doubt, may be repeated indefinitely.

Hence it appears that we have to do with the effects of polarisation well known to all physicists. These effects are due, as is known, to more or less complex compounds formed upon the electrodes, the presence of which gives rise to electromotive forces of a contrary direction to those of the principal action. These compounds are of two kinds, the one kind stable, but capable of being removed by washings, which restores to the battery all its initial electromotive force; the others unstable, dissociable, capable of being destroyed by diffusion, combined to the oxidising action of the air, as is shown by the variation of the electromotive force immediately after the opening of the circuit.

However this may be, the facts just detailed prove that the zinc carbon battery is unfit for any operation which requires a constant electromotive force.

Let us now show the correlative variation of the chemical effects. At the outset, theory indicates that the electromotive force of the zinc-carbon element, as it has been actually measured, should be able to produce any electrolytic reaction which consumes energy inferior to $24·5 \times 1·3 = 32$ calories per equivalent of the body decomposed, I have proved that a zinc-carbon element does not decompose acidulated water (34·5 calories), but on adding a zinc-cadmium element (8 calories, which makes 40 calories) the decomposition is produced.

Two zinc-carbon elements are equal at the outset to 64 calories, they should, therefore, decompose sulphate of potash, and, in fact, they do so. For this decomposition 51·5 calories are necessary.

We see hence the error committed by M. Tommasi, when he believes that he has produced this decomposition by the mere force resulting in two consecutive couples from the formation of sulphate of zinc from metallic zinc and dilute sulphuric acid. In reality such a force is incapable of producing any electrolytic decomposition which consumes more than $19 \times 2 = 38$ calories per equivalent. If two zinc-carbons decompose sulphate of potash whilst two zinc-platinums are unable, it is because the chemical reactions which develop the electromotive forces are not the same in the two systems.

Let us pursue this demonstration: as the electromotive force of the zinc-carbon decreases, its chemical power diminishes. After some hours, when the measurements show that the force of the two zinc-carbons is fallen below that of two Daniells (49) they cease to decompose sulphate of potash (51·5). When it is reduced to that of two zinc-platinums (36 — 38) they still decompose acidulated water (34·5), but it is necessary to connect to them two zinc-cadmiums ($38 + 16 = 54$) to decompose sulphate of potash the addition of a single zinc-cadmium being insufficient.

If I have thought it necessary to insist upon these facts, upon the direct measurement of the electromotive forces and on their continuous correlation with the energy brought into play in chemical reactions both within and without the pile, it is that there may exist neither doubt nor confusion on the fundamental laws of electro-chemistry.

M. Tommasi replied to this as follows:—

Hitherto it has always been admitted that in any element whatsoever the nature of the positive electrode had no influence upon the electromotive force, provided that this electrode was not attacked by the exciting liquid. In the bichromate of potash element alone a difference has been observed in the electromotive force, according as the positive electrode was of platinum or of carbon. I have already pointed out this fact, and I shall return to it in detail in speaking of the chromic acid element. As for Smee's element with dilute sulphuric acid, it has always been believed that the nature of the positive electrode does not sensibly affect its electromotive force. "It is thus," says M. Du Moncel, "that silver, lead, carbon, copper, aluminium, iron in the passive state, have been able to be substituted for the platinum of Smee's battery, without any difference in the electric action other than that derived from the polarisation which these plates might effect.

It appears, therefore, that the augmentation of the electromotive force which I have demonstrated in the zinc-carbon element constitutes a novel fact, not without a scientific interest.

It is known to all that the electrolytic work effected by an element is so much the more considerable as its electromotive force, measured by the electrometer, is more intense. Consequently it is not surprising that M. Berthelot has found, by means of Mascart's electrometer, that the zinc-carbon element has a greater electromotive force than a zinc-platinum element. Since it is known, according to my experiments, that the chemical work produced by the zinc-carbon element is much greater than that obtained with the zinc-platinum element, it would have been, indeed, strange and contrary to all known facts if the electrometric determinations executed by M. Berthelot had proved the contrary.

I had intended to complete my researches on the zinc-carbon element with electrometric determinations; but as M. Berthelot has anticipated me it only remains for me to observe that all the experiments which this *savant* has

described in no way tell against my researches, but, on the contrary, give them a greater degree of certitude. I have never said that a zinc-carbon element was equal to a zinc-platinum element, for the simple reason that I have proved quite the contrary. I have certainly not sought to show that the zinc-carbon element produced an electromotive force greater than the zinc-platinum element, in order to infer that these elements were mutually equivalent.

In my last note I have merely brought forward facts, and these facts are perfectly exact, as M. Berthelot has been able to convince himself when he repeated my experiments, in order to complete them by electrometric determinations. As to the interpretation of these facts I have not said a word, and consequently M. Berthelot ascribes to me things which I have never thought.—*Comptes Rendus.*

GARNIER'S COMBINATION RHEOSTAT.

THE combination rheostat of M. Garnier, which was exhibited at the Electrical Exhibition at Paris in 1881, has for its object the immediate combination of a number of resistances, so as to form a total equal to any required value. The resistance boxes usually employed contain bobbins which are multiples of an arbitrary unit, the ohm, for example, and are so selected, that they can be grouped together, so as to form any required total; by this arrangement any resistance whatever, from the unit upwards and varying by equal graduations, can be obtained. Thus, with the multiples which have been long employed, namely, 1, 2, 2, 5—10, 20, 20, 50—100, 200, 200, 500, any number from 1 to 10,000, each differing by one unit, can be formed, provided that one does not exceed twice the last term of the series. But if it is required to form rapidly any given resistance, it is difficult to avoid various changes of the plugs, in order to obtain the required combination; this operation is analogous to the operation of weighing, and one knows how much time is lost in the employment of a balance and marked weights.

With the cylindrical rheostat one can form immediately any arbitrary rsistance, and can also increase or diminish it regularly by degrees corresponding to any decimal unit. This apparatus consists of a certain number of dials, units, tens, and hundreds, for example, each having eleven divisions (0 to 10), over which a pointer moves. Each needle is mounted on the axis of a cylinder, which has for its object, in each of its positions, the introduction of such bobbins as will together form the exact resistance indicated by the pointer. The "unit" cylinder is connected to bobbins 1, 2, 2, 5; the "ten" cylinder is connected to bobbins 10, 20, 20, 50, and so on. It will be sufficient to explain the construction of one of these cylinders. Let us suppose the four bobbins to be connected, as indicated by fig. 1, to five metal plates, A, B, C, D, E; if these plates

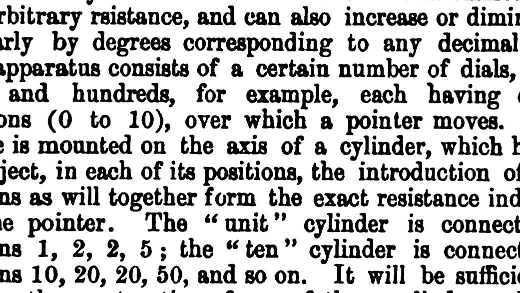
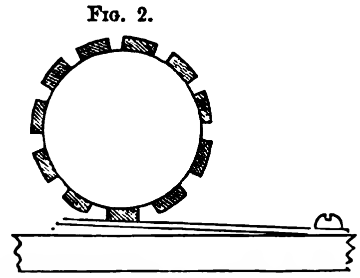


FIG. 1.

remain insulated from each other, the circuit M, N, contains the resistance of all the bobbins, that is to say, 10 ohms; if a combination is effected by metallic connections, of inappreciable resistance, of the three plates, C, B and E, for example, then the resistances, 5 and 2, become cut out of the circuit, and a resistance of 3 only remains in circuit; thus by a proper union of the plates any resistance from 0 to 10 can be obtained. The metallic connections are effected by bands of metal fixed around the circumference of the combining cylinder (fig. 2), the development of which is shown by fig. 3.

The five plates of fig. 1 are formed of five springs which press together on the connecting plates of the cylinder. It can easily be seen that the lengths and the positions of the metal strips are arranged so as to introduce in the circuit those bobbins the sum of whose resistances forms the series of numbers 0 to 10. The cylinder, it is evident, is made of

FIG. 2.



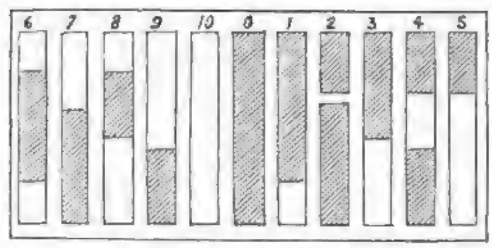


FIG. 3.

an insulating material, wood or ebonite. The plates, A, B, C, D, E, are fixed at one extremity and have sufficient elasticity at their free ends to allow of the rotation of the cylinder, and of the various strips of metal being brought into the eleven different positions which they can take up.

The "ten" and "hundred" cylinders are arranged in the same way as that for the "units," and the circuits, M, N, of the three cylinders are alike. The cylinders can be placed in a box arranged like a Wheatstone bridge, and furnished with proportional branches. The same arrangement of cylinders can be equally well applied to the grouping of condensers.—*Annales Télégraphiques.*

THE ELECTRIC LIGHTING BILL.

IN the House of Lords on Thursday, August 3rd,

Lord Sudeley moved the second reading of the Electric Lighting Bill. The public are by this time so familiar with this measure that it will not be necessary to repeat the noble lord's observations at any great length. He pointed out the rapid and extensive growth of electric lighting in recent years, and the necessity for legislating upon the subject in such a way as to prevent the creation of such monopolies as those of gas and water—not always to the benefit of the public. He recited the leading provisions of the bill as it left the other House, and related the proceedings both of the recent Committee and of that in 1879. In support of the licences provision, he argued that the necessity of companies going before Parliament and being prepared for an outlay at once of £10,000 or £12,000 would practically retard the development of electric lighting to a serious extent, whereas the proposed system of temporary licences would be both simple and cheap, and therefore of great advantage to the community at large. The objections of the gas companies he dismissed with the remark that they naturally did not like an innovation which threatened their interests, although they had no real legal monopoly in the supply of light; and in conclusion he promised that the Board of Trade, not desiring to hamper the operations of electric companies, would be ready to modify any terms that might be found too hard.

Lord Emly did not advance any obstacles to the bill, but he regretted that it had come up so late that it could hardly receive adequate consideration. He likewise regarded the case of the gas companies lightly, but he expressed a fear lest the clause (27) which would enable an early purchase by local authorities might deter people from entering upon undertakings, especially the system being still largely experimental, could hardly yield any return in less than fifteen years, when undertakings could be bought up without compensation.

The Earl of Crawford and Balcarres, who, as Lord Lindsay, sat on the Committee of 1879, also objected to the 27th clause, pointing out that although a fair price would be given for an undertaking, yet plant and machinery would be depreciated by something like 50 per cent., which would, of course, be so much loss to the original company. For that reason he feared the purchasing powers would be a serious hindrance.

[illegible]

THE ELECTRIC LIGHTING OF THE COMPTOIR D'ESCOMPTE BY BICHROMATE BATTERIES ON THE JARRIANT AND GRENET SYSTEM.

CAN batteries charged with liquids be employed for electric lighting on a considerable scale without the expense involved in their use being out of all proportion to the result obtained? All the experiments made up to the present have given a negative res[illegible] t this has not prevented inventors from continuing [illegible] ches in this direction, and in the ardour of [illegible] ions these *savants* have persuaded capitalis[illegible] s to make the necessary sacrifice in order t[illegible] a practical shape, and to bring them within [illegible] mplished facts. Considered entirely

[illegible] The solution of bichromate of soda is prepared beforehand in large quantities at the workshop and is pumped into large reservoirs at the top of the building. From there it is brought below to each battery by a special pipe service—very well arranged although rather complicated—provided with taps of ebonite and pipes of india-rubber.

The fresh liquid can be used three times over. The first time it flows at the rate of 20 litres per hour, and through the battery of 48 elements; the second time at the rate of 30 litres, and the third time at the rate of 40 litres. By adding a little of the fresh liquid it can be used over for a fourth time. When thus used it drains through at the rate of 60 litres per hour per battery; after which the liquid goes through a process of regeneration. MM. Jarriant and Grenet profess to be in possession of an economical process for the regeneration of the liquids, a process which allows of the separation of the chrome and the zincs from the alkaline sulphate, by a new method. This process, which is no longer a secret, being patented by MM. Jarriant and

Grenet, appears to us to be decidedly complicated. The following is a rapid enumeration of the manipulations necessary to effect the regeneration of the products :—

1st. The saturation of the excess of sulphuric acid by carbonate of lime ; the precipitation of the sulphate of lime, of the oxide of chrome, and of the carbonate of zinc. The liquor which remains contains alkaline sulphate.

2nd. The decantation, concentration, and crystallisation of the alkaline sulphate.

3rd. The separation of the carbonate of zinc from the oxide of chrome, and of the sulphate of lime, by a certain quantity of sulphuric acid, which is calculated exactly to transform the carbonate of zinc into sulphate of zinc. The liquor which remains contains sulphate of zinc, which is concentrated after decantation for crystallisation.

4th. The desiccation, pulverisation, and mixing of the sulphate of lime and oxide of chrome with quicklime and the alkaline carbonate.

5th. The calcination of the above mixture on the hearth of a reverberatory furnace and the extraction of the chromate by *known processes.*

We see that the generation of the products is by no means a simple operation, involving, as it does, five processes, not counting the *known processes,* and the carriage of the liquids from the Comptoir to the workshop, and from the workshop to the Comptoir.

Let us now return to the batteries. We can see that the overflow pipe serves to maintain the level constant in the elements in proportion as they are filled with fresh liquid ; this circulation of the liquid serves in a certain degree to keep the current constant, a constancy still more preserved by an aeration produced in each element by means of two tubes of ebonite, which plunge into the bottom of the liquid. In order to obtain the air necessary for the aeration without special expense, advantage is taken of the compressed air used for the pneumatic transmission of messages between the various offices of the Comptoir.

Under ordinary conditions, the volume of air furnished to each battery is about three cubic metres per hour, under a pressure equal to the height of the liquid in the elements, or about 15 to 20 centimetres of water.

The installation is completed by a supply of water for cleaning the elements, and a double sink for the discharge ; one of the sinks is employed for remixing the liquid for charging the batteries, the other holds the water for washing the elements and conducts it into the sewers.

The negative pole of each battery is connected to a common lead wire, the positive pole is joined to a commutator which has fifty bars. The feeding apparatus is also connected to a common negative lead wire, and the positive poles are attached to the same commutator ; the batteries occupy the horizontal bars and the lighting apparatus the vertical ones. We only require, therefore, to place a peg where two given bands meet in order to establish communication between a battery of a given number and a given series of lighting apparatus. Either the Swan incandescent lamps or the arc lamps of Siemens, Gravier, &c., are used as occasion requires. Each battery of 48 elements in series has an electromotive force of 82 volts, and can give as much as 24 ampères on a short circuit. We see by these figures that a single battery is sufficient to feed a number of incandescent lamps or a voltaic arc with 10 carbons of 10 millimetres, which works very well with 10 ampères. We can besides group several batteries in tension or in quantity as occasion may require, in order to supply more powerful arc light or a larger number of incandescent lamps ; it is with this object and also for the purpose of having a few reserve batteries that the commutator has only 50 positions, although the complete installation should have 60 batteries.

The employment of a distinct wire for each lamp, and of a wire for each battery, the negative being in common, constitutes rather a serious expense at the first installation, but it has the advantage of rendering the apparatus, lamps, and batteries absolutely independent of one another. In case of accident it is easy to localise it and repair it, and thus the accident is never very serious. An indicating table, arranged opposite the Swiss commutator, enables the lighting of any given hall to be regulated from a distance ; the workman charged with the superintendence of it knows which are the right batteries to work, and has only to place the pegs. Besides, the lamps can be lit or extinguished at will by commutators arranged in the hall, when communication is established between a battery and a given circuit by means of the Swiss commutator.

Such is the principle of MM. Jarriant and Grenet's installation of bichromate batteries for the lighting by electricity of the Comptoir.

The future will throw some light on the economic view of the question, concerning which we have as yet very vague ideas. This point will decide the future of the installation ; but whatever fate may be reserved for it, it was no less interesting to describe the general outline of an installation in which for the first time for industrial purposes and practical application an electrical energy of fifty horse-power has been produced by the employment of liquid batteries.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

A MAGNETOMETER FOR THE DETERMINATION OF THE POLE STRENGTH OF MAGNETS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—While occupied in the study of magnetism I have devised a little instrument by which the pole strength of magnets may be determined in absolute units. As it is not difficult to arrange and gives good results I venture to send it to your Review, as it may possibly be of use to some who are engaged on the subject of magnetism.

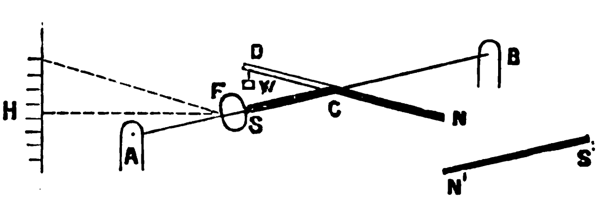
Yours faithfully,

FREDERICK JOHN SMITH.

Taunton, *July 28th*, 1882.

DESCRIPTION.

A magnet of rectangular shape, S C N, having a brass counter weight, D C, equal in length to C N, is attached to a torsion wire, A B, stretched between two pillars ; it is furnished with a mirror scale and lamp, F H. The magnet is made of rectangular form in order that the south pole may be placed in the axis of the wire, and thus out of the influence of side pull of the magnet, N′ S′. By a milled head at A different amounts of torsion can be given to the wire. To use the instrument the magnet, N′ S′, is removed, and the magnet is placed in a horizontal position, and the scale reading taken. A known weight, W, is now placed at D, and the new scale reading recorded. The weight is now removed, and the magnet, N′ S′, of equal pole strength is slowly raised under the N pole of the rectangular magnet until the same reading on the scale is obtained as when the weight was on, thus the repulsion of the two equal poles is equal to the effect of the weight, W. (No great difficulty is found in making magnets of equal pole strength by a peculiar process.)



Now, we know that the force, *f*, acting between magnetic poles it stated by the formula

$$f = \frac{s \times s'}{d^2}$$

where S S′ denote pole strength and *d* distance between them in this instrument, $s = s'$, so the formula may be written

$$f = \frac{s^2}{d^2}$$

and *w g* can be written for *f* where *w* denotes the numerical

value of the weight and g = gravity force ; from this s is at once known ; the weights are part of the gramme, and the distance, d, is measured in centimetres. The rectangular magnet has been used by me to construct a virtually one-pole magnet some years ago. When the strength of one-pole has been determined other magnets and solenoids can at once be compared with it, the magnet, N′ S′, is raised into position by a micrometer screw.

THE RIVAL TELEPHONE COMPANIES.

To the Editors of The Electrical Review.

Sirs,—The public has no doubt heard with no unmixed pleasure the announcement by "The London and Globe Telephone and Maintenance Company (Limited), that it intends to construct and maintain and provide telephone lines and exchanges on more advantageous terms than those of existing companies, so as to place the telephone within reach of all classes of society." The United Telephone Company has lost no time, however, in bringing to the notice of the public several judicial facts bearing upon certain of the patents advertised as part of the purchase to be made by the new company for the moderate sum of £130,000. The public, however, are too familiar with the preposterous claims heretofore set up by the United Telephone Company to give credence to all that company may publish. In this case, however, it would appear that Mr. Justice Fry did decide that the Hunnings' transmitter, "having the combination of a diaphragm with a tension regulator," was an infringement of Edison's patent, which patent, however, Mr. Justice Fry felt compelled by the evidence before him to declare to be void, because of a claim in it not justified by the provisional specification.

Now, however, the fiat of the Attorney-General has been granted, and the objectionable claim of Edison has been disclaimed—and his patent stands valid—and any transmitter combining a diaphragm with a tension regulator, be it Hunnings', Dolbear's, or Ander's, is clearly an infringement of Edison's patent, according to the decision of Mr. Justice Fry.

When schemes, for which the too easily gulled British public are asked to subscribe, embrace the development of scientific discussion, it might be advisable for it to consult scientific publications instead of the financial newspapers of the day.

JUSTICE.

10th August, 1882.

MULTIPLE TELEPHONE SIGNALLING.

To the Editors of The Electrical Review.

Sirs,—I beg to offer a few remarks on the article describing Mr. Kettell's individual telephone call and signal, in the number for July 15th. It is a difficult task to give a detailed description of such an instrument, and great credit is due for the lucid manner in which the working was explained.

"The proof of the pudding is the eating." I therefore speak with all deference to the statement that the system has been in practical use for over a year and a half, and has proved a perfect success, but it would appear to me that the following difficulties would seriously affect the prospect of its general introduction into this country :—

1. Each subscriber could interrupt and overhear the conversation of any other subscriber on the same line.

2. Any mischievous person might without fear of detection, ring up all the subscribers on the line by pressing his button when he observes the clockwork going.

3. The subscriber who first calls is kept waiting with his telephone to his ear until the exchange answers him, and after that until the attention of the person he wishes to speak to is gained. This is very wearisome compared to the separate line system, under which the subscriber simply rings up the exchange, and having given the number of the firm he requires, may leave the instrument until his bell is rung again as a warning that the person he asked for is in readiness to speak.

4. No. 1 rings up the exchange, and in doing so sets all the discs to "line occupied"; he says he wants to speak to No. 5 (who is on the same line). How is the attention of the last-named to be obtained ? Must not the exchange go through the process of clearing the line, and then ring him up by pressing the button, p, as in other cases ?

5. The amount of work thrown on the operators would appear to be very heavy ; they would not only have to wait until the clock ceased running before connecting two lines together, but would have to send clearing currents after each of them after the expiration of the three minutes allowed for speaking.

One man could not, I suppose, do the switching for more than thirty subscribers (six lines of five stations each).

6. In the event of the person who is being called not attending to the first ring of his bell, a clearing current would have to be sent from the exchange along the line, and the process of ringing him gone through again, during which time the subscriber who first called would be patiently waiting with his telephone to his ear.

Taking the difficulties above enumerated into consideration and the thousand and one peculiar incidents which occur in the use of exchange lines, I do not think that we have yet arrived at a satisfactory solution of the problem how to connect several subscribers up to an exchange on one wire, and at the same time give them an efficient service.

The best arrangement I have yet seen for the purpose was that designed by Messrs. Brown & Saunders, and shown at the recent Crystal Palace Exhibition. A description of it was given in one or two of the scientific papers. The following is an extract from one of these, from which it will be seen that very important results are obtained :—

"The object of this apparatus is to place a number (say 11) telephonic subscribers in series on one line, in such manner that either one may call up and speak to another without disturbing the remainder and without the possibility of any of the remaining subscribers either calling or overhearing the conversation or of interrupting by ringing until the caller clears the line.

"An automatic arrangement is also provided which ensures that the caller shall not neglect to so clear the line when he has finished speaking."

The telephone industries are now assuming very large proportions ; a great variety of opinion exists as to the best form of switch boards, subscribers, instruments, transmitters, line work, &c. It appears to me at once strange and regrettable that in this country telephonists have not before exchanged views and discussed these questions through the medium of a paper. I am, Sirs,

Yours faithfully,

WM. L. MADGE.

Belfast, *August 5th*, 1882.

ELECTRIC LIGHTING.

To the Editors of The Electrical Review.

Gentlemen,—In Mr. Humphreys' letter to your journal of the 5th inst., making, no doubt, allowable excuse for the Brush failures, he says, "In this the first attempt ever made at street lighting in this country." Now, "fair play is a jewel," and long before "Brush" was ever heard of the "Jablochkoff" system lit the greatest thoroughfare in Europe, and has done so for nearly four years, and never had an extinction, until for once lately, by the piston rod of the engine breaking.

Faithfully yours,

R. SPEAR BEGBIE.

August 5th, 1882.

THE CITY AND GUILDS OF LONDON INSTITUTE TECHNOLOGICAL EXAMINATION.

To the Editors of The Electrical Review.

Sirs,—In "Fareham's" interesting and suggestive article in your last issue, on the recent technological examination held under the auspices of the City and Guilds of London Institute, he mentions what appears to be an anomaly in the result of that examination. The particulars which he gives of this case tally exactly with those known to me, and if I am right in believing they refer to the same circumstances, perhaps, as one better acquainted with the facts, I may be permitted to correct the erroneous view he has formed of them, and which he may have led readers to share. Your correspondent is quite wr-

stating a clerk of only six months' study managed to secure an honours' "pass," while another of six years' theoretical and practical experience was plucked, and using this as an argument to show the weakness of the present examinational system. The truth is, the successful clerk has had a few years of study, and it has not been all theoretical, though he has never acted as a "test" officer. "Fareham" is not very successful in explaining the cause of the failure of one so deserving of honours. Is it conceivable that one who five years ago secured a first class certificate in electricity and magnetism could have failed to pass in honours through inability to express himself? But, whatever may be the true reason, it is scarcely fair to make use of the result to cast reflections on the quality of the knowledge possessed by a successful candidate, and to question (even though indirectly) his right to an honour which he has striven hard for.

"Fareham" assures us this "anomaly" is by no means an isolated one, but I am inclined to think that if the others were examined into they would admit of a more creditable explanation. I do not believe that any one, however excellently crammed or coached, could pass ordinary or honours in telegraphy without a considerable practical knowledge of the subject.

ABA.

August 7th, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The keynote of the annual wail from disappointed teachers has been struck by your correspondent "Fareham," in a letter which is valuable, so far as the tabulation of the examination results and his remarks thereupon go, but which, in other respects, has not a very logical connection between its premises and conclusions.

A quotation is made from an address of Colonel Webber, in which instruction in the workshop and laboratory, and the hand-in-hand march of *theory* and *practice* is advocated; and your correspondent goes on to state, that such a course cannot be gone through at the City and Guilds classes so long as the present system of examination continues, so long as students gain prizes, and teachers grants, by mere "cram" knowledge. I venture to think this charge against the City and Guilds examinations is quite unfounded. The questions set at the May examination seem to have been specially directed against "cram," and no student who had not combined a practical, with a theoretical study of the subject, could have answered them satisfactorily.

To support his case, "Fareham" cites an instance where a student, who has devoted five years of his time to the study of technical telegraphy, and who discharges from time to time the duties of a testing officer, was plucked, while a six months' (?) student gained an honour's place. "There is but one explanation of such an anomaly," adds your correspondent, "and it is the failure of the five years' student to express himself on paper."

Practical examinations are, therefore, demanded. Without discussing whether a student who fails at a written examination would be more successful at an oral one, I would point out that this "anomaly" is singularly at variance with the position taken up by "Fareham," proving, as it does, that there may be too much *practice* and too little *theory*. There are many very good testing officers who carry out their duties with care and exactitude, and with a certain amount of "knowingness" to boot, whose real knowledge of the principles of testing never rises above the rule of thumb; and probably the five years' student's relationship to this class of technical officers may account for his inability to express himself on paper.

Undoubtedly a great cause of failure at these examinations is the temptation which first year's students have to compete in the honours grade. This is due to the practice of carrying on the teaching for both grades at the same time, there being no distinction between ordinary and honours subjects in the syllabus supplied to teachers. Were the City and Guilds Institute to take an example from the Science and Art Department in this respect, and issue a syllabus stating clearly and fully the ground to be covered in each grade, teachers and students would be alike benefited. The teaching would then be thorough and definite, the class being necessarily elementary or advanced. It would not then be needful to hurry over the entire subject in one short session as at present, and students would no longer have it in their option to bring discredit on themselves and their teachers by aspiring beyond their qualifications.

Yours truly,

MAGA.

THE UNITED TELEPHONE COMPANY.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I venture to send to you a few comments on the reports made by the directors of the United Telephone Company (Limited) to the two general meetings of their shareholders, held respectively on August 9th, 1881, and on August 1st, 1882.

The nominal capital of this company is £500,000, of which it appears that £400,000 had been paid in for shares prior to August 9th, 1881, the date of the first general meeting. In that report it was stated by the chairman that in the months of May, June, and July, 1880, there were 609 subscribers; in August, September, and October, 707; and in December, January, and February, 820; and on August 9th, 1,052. The total receipts from all sources were £20,644, and the working expenses were £20,273, thus showing a surplus of £371 over and above working expenses, with which a dividend of one-twelfth of one per cent. might have been paid on the £400,000 paid-up capital—a result which could not have been very satisfactory to the 600 shareholders. But the Lancashire and Cheshire Telephone Company fortunately arrived in time to assuage their grief, and a bonus of 10s. per share upon the issued shares of the United Telephone Company was paid out of the sum of £50,000 cash received from the Lancashire and Cheshire Telephone Company, leaving a balance of £10,000 to be carried to the reserve fund, applicable to the general purposes of the company. The United Telephone Company received also from the Lancashire and Cheshire Telephone Company 50,000 of their fully paid-up shares of £1 each.

At that meeting the chairman said, "I don't want to bother you with figures, but here are some remarkable statistics compiled by our auditors, showing the increase in the number of our subscribers, and, above all, the decrease of the expenses." The few figures which the chairman did put forth must have bothered greatly the shareholders, as those figures gave to the shareholders the not welcome information that the company had earned only £371 during the year, notwithstanding the "remarkable statistics compiled by the auditors." The one great fact which stands forth conspicuously in that report is that the United Telephone Company, with 1,052 subscribers to their London exchange, earned only enough to cover their working expenses.

Now I turn to the report submitted on the 1st inst. to the general meeting of the shareholders.

The receipts from all sources for the year have been £42,624, and the working expenses £21,050; the balance net revenue, £21,945, from which a dividend of 5 per cent. was paid on £400,000 paid-up capital, leaving a balance of £1,945 to be carried forward.

It is no doubt gratifying to the shareholders that their telephone exchange has paid them a dividend of 5 per cent., less income-tax.

Is it possible that the 600 shareholders who have paid £400,000 into this company's coffers can be satisfied with a dividend of 5 per cent. when they consider that Bell's patent will expire in eight years, in December, 1890, and Edison's patent in July, 1891, for which the company have paid fabulous sums of money; to which must be added the money paid for Crossley and Blake's patents, making a total of nearly £300,000, which large sum of money will have entirely disappeared in nine years. No mention is made in either of the reports of any provision for a sinking fund to make good to the shareholders the capital sunk in patents. Perhaps they are satisfied with the *patent* sinking fund they have. The report announces the formation of two new companies affiliated to the parent company, viz., the Telephone Company of Ireland, nominal capital £200,000, of which the United Telephone Company receives 87,500 shares of £1, and a payment of annual royalties on each instrument used; the other company is the Western Counties and South Wales Telephone Company, nominal capital

£275,000, of which the United Telephone Company receives 125,000 shares of £1, and annual royalties on each instrument used. If these companies can earn dividends of course the United Telephone Company will receive its share of them. That the prospect is good may be doubted, when the prolific parent company's exchange in London, with its 4,000,000 population, could only pay its expenses during the first year, and only 5 per cent. for its second year.

The abnormal high price of the shares of this company is an enigma.

The statement made by the chairman at the first general meeting that the United Telephone Company had secured in its own hands "all the patents of value in this country, and that it has the *monopoly* of the telephone in the United Kingdom," no doubt has had its effect upon the general public, who, believing in those (I may say) preposterous claims, fancy they hold a monopoly of telephony in the United Kingdom. Even in the report submitted on the 1st inst. that illusion is attempted to be kept up by the remarks of the chairman, that "if any persons do obtain a licence from the Postmaster-General they will first have to obtain proper instruments to carry out the business, which I think at this moment is rather *a doubtful enterprise on their part.*"

It is possible—aye, probable—that the general public will sooner or later be convinced that this company's security in a monopoly is a myth, and will learn to its cost that the fancied security in a monopoly expressed by their chairman resembles closely the fancied security of the ostrich, which sapient bird hides its head and believes its pursuers cannot see it because it has concealed its own eyes.

The telephone is an useful instrument, and will become a necessary one so soon as instruments can be procured at a reasonable price, which desirable end cannot be obtained from a company which has paid hundreds of thousands of pounds for a fancied monopoly.

COMMON SENSE.

London, *August 9th*, 1882.

NOTES.

ERRATUM.—ELECTRICAL REVIEW.—In the letter of Prof. Silvanus Thompson, headed "The Telephone," in our issue of August 5, 1882, p. 87, col. 1, line 12, for "1863" read "1861."

DANGER FROM ELECTRIC LIGHTING.—We read in the daily press that an accident, attended with fatal results, occurred on Sunday evening, in the Tuileries Gardens, in Paris, during the display of fireworks. Two men, in attempting to climb over the railing, caught hold of the electric wire used for the illumination of the grounds, and were struck dead on the spot, all efforts to restore them to life proving ineffectual.

OPPOSITION TO A PATENT FOR IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES.—In the opposition to the application by Mr. W. H. Akester, of the Universal Electric Light Company, Limited, for letters-patent for improvements in dynamo-electric machines, the Attorney-General heard counsel for parties on Saturday last. On account of the allegations and counter-allegations in the declarations, while permitting the patent to proceed, he declined to allow the applicant costs. In reply to counsel on both sides, the Attorney-General stated that as his tribunal was one before which parties could not be cross-examined upon oath, he should for that reason allow the patent to proceed, leaving the applicant to his remedy in open court. Application for provisional protection was made and granted on 17th December, 1881 (No. 5525), and on notice to proceed being given, opposition was lodged against the patent being sealed by Mr. David Graham, electrical engineer to the Railway Appliances and Electric Company (Limited). The grounds of opposition were: (1) That the patent was an infringement of a patent which Mr. Graham had previously acquired—this ground was afterwards abandoned; and (2) that the invention was that of Mr. Rankin Kennedy, another *employé* of the company, and not the invention of Mr. Akester, while the latter maintained that the invention was exclusively his own. The application and opposition have been fought keenly for several months past, so great is the intrinsic value of the invention believed to be, many declarations and exhibits having been made on both sides. The matter is by no means finally disposed of, and Mr. Kennedy has upon the advice of his counsel instructed his agent to oppose the applications before the Lord Chancellor.

EXTINGUISHING THE ELECTRIC LIGHT.—For maliciously extinguishing the electric light in St. Enoch Station, Glasgow, Peter Smith, who had been an *employé* of the Glasgow and South Western Railway Company, was fined two guineas, with the alternative of twenty days' imprisonment, at the Central Police Court of Glasgow on Monday last.

THE ELECTRIC LIGHT AT EDINBURGH.—After the unfortunate failure of the electric light as an Edinburgh street illuminant, it is gratifying to learn that the installation made twelve months ago at the Waverley station of the North British Railway Company has been so successful that the company has decided that "the light of the future" shall shed its rays not only over the main portion of the station, but even unto its outermost platforms.

ELECTRIC LIGHTING IN THE ROYAL AQUARIUM.—We understand that a prize of 100 guineas is to be offered for the best and most durable system of incandescent electric lighting in the forthcoming exhibition, to be held at the Royal Aquarium. Each competitor is to be limited to 100 lamps, and these are to be kept in action during the whole time that the exhibition is open. Tests on each system will also be taken at intervals. We believe that it will be stipulated that when each installation is fairly started no part of it shall be subject to any additions or alterations unless duly reported.

THE WINTER ELECTRICAL EXHIBITION AT THE ROYAL AQUARIUM.—Doubtless most of our readers are already acquainted with the contents of the prospectus issued by the directors of the Royal Aquarium. The space at command being limited, the installations of individual exhibitors will be restricted, so that all may be placed upon an equal footing. Attention will be concentrated more particularly on electrical matters which have hitherto been imperfectly touched upon. Copies of the prospectus, together with a lithographed plan of the Aquarium building, may be obtained on application to Mr. Will. D. Gooch, the engineer to the exhibition.

ELECTRIC LIGHTING IN LIVERPOOL.—The Pilsen, Joel, and General Electric Light Company, Limited, on the evening of Wednesday, the 2nd inst., lighted the extensive music warehouse of Mr. W. Lea, in Church Street. Four Pilsen arc lamps, each giving a stated light of 2,000 candle-power were employed, the current being produced by a Schuckert 4-light dynamo-electric machine, driven by a five horse-power Ransome's engine. This and the machine were placed in School Lane, and the length of cable required was about 500 yards. We believe the installation is under the control of Messrs. Woodhouse and Rawson, electrical engineers and contractors, the work however being carried out under the direction of Mr. R. H. Newington. A large number of ladies and gentlemen (including the Lord Mayor, the Lady Mayoress, and several councillors), were present at the invitation of the chairman and directors of the company. These were received by Mr. Beattie, the company's London representative, and Mr. Rawson. We understand that the inauguration passed off in a most successful way, and great satisfaction was expressed by all present at the effect produced by the Pilsen light.

THE ELECTRIC LIGHT AT PAISLEY.—The mansion of Mr. Archibald Coats, at Woodside, Paisley, has now been fitted throughout by the Edison Electric Light Company with the electric light. The total number of lamps fitted up is 200.

THE ELECTRIC LIGHTING BILL.—Two letters in the *Times* of the 8th inst. on the above subject are worthy the

attention of all connected with the electric lighting interests. One is from Mr. Moulton, Q.C., and is written in a similar strain to that of Sir Frederick Bramwell, published in the same paper a short time previously. The second is from Mr. Arnold White, the Secretary to the Edison Electric Light Company.

ELECTRIC LIGHTING IN AMERICA.—The Hotel Vendome in Boston has within the last few days been provided with sixty of the Edison Company's incandescent lights, each having a power of sixteen candles. Mr. William W. Munroe, the Boston agent of the company, says the Edison Company now can fairly claim that it has passed its experimental age, and with its system perfect in all details is now really achieving high practical results. The incandescent light, he adds, as used by the Pemberton, Arlington, Merrimac, and Worrumbo mills, and by numerous prominent business houses throughout New England, is daily proving that it is superior to gas in all ways, while at the same time more economical. We read also that by September one thousand houses in New York will be supplied with the incandescent light in Edison's first district. Since June 1st, according to an American contemporary, Mr. Edison has filed fifty-one applications for electric lighting patents, and that he has now a grand total of 109 patents in this subject alone. Edison lamps have been used for some months in the offices of the Philadelphia *Ledger*, and the plant is now being doubled. The *Record* has also ordered an installation. The United States Illuminating Company is also apparently doing a considerable amount of business. Machines and lamps under the Maxim, Weston, and Farmer patents are manufactured for the company by the United States Electric Lighting Company, and not less than 160 miles of conducting wires for arc lights have been supplied.

OVER FIVE THOUSAND ELECTRIC LIGHTS IN ONE BUILDING.—The Mills Building, Wall and Broad Street, says the *Scientific American*, has been wired for 5,588 Edison lamps. As this is the largest enterprise of the kind ever undertaken the details may prove interesting. The conductors consists of 1,650 feet of Edison's patent electric tubes, 628 feet of lead pipe containing taped wires thoroughly insulated, 23,658 feet of zinc tubes, 75,909 feet of wire conductors, and 24,162 feet of wooded receptacles, placed between the floors, to hold the system of distributed wires. The total amount of wires used was 3,774 lb., besides 48 vertical main cut-outs, and 253 division cut-outs.

THE TELEGRAPH AND ELECTRIC LIGHT IN EGYPT.—The mounted portions of the telegraph troop Royal Engineers, consisting of about seven officers, 184 non-commissioned officers and men, and 65 horses, with two field telegraph equipments complete, and the field pack of the Royal Engineers, including one officer, 33 non-commissioned officers and men, and 26 horses, under the command of Major Sir A. Mackworth, marched from Aldershot on Saturday last, *en route* to the South-West India Docks, London, where they will embark to-morrow in the steamer *Oxenholme* for conveyance to the East.

The telegraph steamer *John Pender*, which arrived at Alexandria with a sufficient supply of cable on board for the projected line between Suez, Port Said, and Alexandria, was recently engaged in important work for the Eastern Telegraph Company between Lisbon and Land's End. Immediately on the decision of the Government, and from the urgency of the case, she was ordered to Alexandria.

A portable steam-engine has just come out for working an electric machine.

Izzet Effendi, Director of the Telegraphs, sent a staff of *employés* on the 3rd inst. to lay and open a cable between Jeddah and Souakim.

The *Superb* used her electric light on the night of the 9th inst. from where she lies, off Count Zizinia's house, but whether it was an advantage or otherwise is an open question. From the distance she had to throw the rays it was impossible for those on board to use the light so as to be of the greatest assistance to our sentries. The officer in charge of the picket said that several times the electric light was thrown on his own men, who thus were themselves exposed to view, and at the same time were unable to penetrate the darkness beyond. This is manifestly turning a valuable appliance into a source of danger, and it shows the inutility and even peril of using the electric light indiscriminately. Arrangements have been completed for throwing the electric light over the enemy's lines from Ramleh.

MOVEMENT FOR CHEAPER TELEGRAMS IN AUSTRALIA.—A number of gentlemen interested in the various industries of the Northern Territory of South Australia recently met to consider the best means for securing a reduction in the cost of telegrams between Adelaide and Port Darwin. After a brief discussion it was decided to bring the matter before the South Australian Government, and the better to attain this object a memorial was prepared to be presented by a deputation to the Minister for the Northern Territories as soon as representative signatures to it are obtained. The memorial suggests that the charge for the first ten words should be reduced from tenpence to threepence.

THE COST OF TELEGRAMS.—It has been suggested that, as a step in the direction of reducing the cost of telegrams, the Post-Office should allow a message of twenty words, the answer to which is prepaid, to be sent for 1s. 6d. The idea is likely to be brought under the notice of the Postmaster-General on an early day.

THE TELEPHONE.—From Birmingham we learn of a new and useful application of the telephone. Between the offices of the Health Department and the borough hospital, three miles distant, telephone communication has been established, in order to lessen the risk of the spread of infection by friends visiting the patients. This method of ascertaining the progress of the hospital inmates is extensively taken advantage of daily.

THE LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY.—This company has been promoted for the purpose of acquiring the telephonic inventions of Prof. Dolbear for a transmitter and receiver (the latter being already well known), and the microphone transmitter of Mr. Anders, together with switch boards, signal bells, and batteries. Included also in the purchase-money (£40,000 in cash, and £90,000 in fully paid shares of the company) is the celebrated "Hunnings" transmitter. No sooner is the prospectus issued than the United Telephone Company informs intending investors through the medium of the press that proceedings will be taken against the new company, the United Telephone Company being advised that the Dolbear, Anders, and Hunnings transmitters are all infringements of the Edison patents. The London and Globe Telephone Company, in response, invite the public to disregard the opposition of the monopolising company. We consider the new company ill advised in bringing forward the last-named transmitter (if they had others equally good), and we hope that the action taken by the United Telephone Company will not have the effect anticipated.

THE NEW ATLANTIC CABLE ENTERPRISES.—In the Senate of the United States, on June 26th, 1882, Mr. Gorman asked and, by unanimous consent, obtained leave to bring in the following bill, which was read twice and referred to the Committee on Foreign Relations. On June 27th, 1882, it was reported by Mr. Windom with amendments, viz., to insert the parts printed in *italics* :—

A BILL

To encourage and promote telegraphic communication between America and Europe.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Robert Garrett, William F. Burns, and William F. Frick, of Maryland, their associates, successors, and assigns, shall have the right to construct, lay, land, and maintain a line or lines of telegraph or submarine cables on the Atlantic coast of the United States of America, to connect the American and European coasts by telegraphic lines, wires, or submarine cables: *Provided, That said company shall begin to lay said cable or cables within one year from the passage of this Act: And provided further*, That no amalgamation, union, or sale of cable interests established under this Act shall be made to any existing European or other cable companies.

SEC. 2. That any telegraphic line or cable laid be subject to the following conditions, stipulations, and reservations, to wit:

First. The Government of the United States shall be entitled to exercise and enjoy the same or similar privileges with regard to the

control and use of such line or lines, or cable or cables, as there may by law, agreement, or otherwise be exercised and enjoyed by any foreign government whatever.

Secondly. Citizens of the United States shall enjoy the same privileges as to the payment of rates for the transmission of messages as are enjoyed by the citizens of the most favoured nations.

Thirdly. The transmission of despatches shall be made in he following order; First, despatches of state, under such regulations as may be agreed upon by the governments interested, the rates not to exceed those charged to individuals; secondly, despatches on telegraphic service; and thirdly, private despatches.

Fourthly. The lines of any such cables shall be kept open to the public for the daily transmission of market and commercial reports and intelligence, and all messages, despatches, and communications shall be forwarded in the order in which they are received, except as hereinbefore provided.

Fifthly. Before extending and establishing any such line or lines, or cable or cables, in or over any waters, reefs, islands, shores, and lands within the jurisdiction of the United States, a written acceptance of the terms and conditions imposed by this Act shall be filed in the office of the Secretary of State by the parties above named, or a majority of them, their associates, successors, or assigns, or by the company or corporation which may be organised to construct and operate cables under this Act.

Sec. 3. *That nothing in this Act shall be construed to limit the United States in granting to other persons or companies similar privileges herein contained.*

Sec. 4. *That the right to alter, amend, or repeal this Act at any time is hereby reserved to Congress.*

The *Baltimore Sun*, of July 24th, in alluding to the company promoting the above bill gives a somewhat lengthy sketch of the Baltimore and Ohio telegraphs, and also has an article on the subject of the Baltimore and Ohio Telegraphic Cable Company, from which we extract the following :—

The Baltimore and Ohio Telegraph Company announces a list of 535 points in the United States and 33 in the Dominion of Canada which are reached by its own and connecting lines. The places thus reached are in Kansas, Missouri, Wisconsin, Minnesota, Michigan, Illinois, Indiana, Kentucky, Ohio, West Virginia, Virginia, Maryland, District of Columbia, Delaware, New Jersey, Pennsylvania, New York, New Hampshire, Rhode Island, Vermont, Massachusetts, Connecticut, Maine, and Canada. The States through or into which the Baltimore and Ohio Company's own lines extend are Missouri, Illinois, Indiana, Ohio, Kentucky, West Virginia, Virginia, District of Columbia, Maryland, Delaware, New Jersey, and Pennsylvania. The principal cities thus placed in communication with Baltimore are St. Louis, Chicago, Louisville, Cincinnati, Columbus, Sandusky, Pittsburg, and Washington, &c.

The announcement was made on Saturday that the Baltimore and Ohio was preparing to build its own line from Baltimore to New York, and it was stated in official circles that the company would have its own wires through to New York in a very few months. The line is being built through New Jersey this way, from the New York end, and operations will soon begin on the Baltimore end. The Baltimore and Ohio already controls the wire to New York, and when their own is finished will have a through wire from New York to St. Louis. . . . . . In the year 1879 a bill was introduced in Congress to permit railroad companies to do a general telegraph business, most of the railroads having erected their own lines and made contracts of various kinds with the telegraph companies.

This bill anticipated and provided a way for the designs of the railroad companies to form among themselves an opposition to the Western Union Telegraph Company. The Baltimore and Ohio lines formed a very important factor in the American Union system, but their value was only partially acknowledged by the Western Union management. When a new contract was prepared by the Western Union and Baltimore and Ohio for future harmonious operations, certain features of it were objectionable to the Baltimore and Ohio. The Western Union refused to modify it, and the Baltimore and Ohio declined to accept it, and from that time the Baltimore and Ohio has been pushing its own lines with the view of forming the only thorough opposition to the Western Union system.

Following this closely came the announcement that the Baltimore and Ohio was preparing to lay an independent cable between Europe and America, the western end of which will most likely be landed on the Maryland shore. But should the Chesapeake and Delaware canal project succeed it will most likely be landed at Lewes, Delaware, or whatever point is selected as the outlet of the canal. In telegraph circles, however, it is believed that the new cable will be landed in New York, in spite of the announcement that it would probably be landed in Maryland. It is stated that nothing definite will be done in the cable matter until the fall, upon the return of Mr. Robert Garrett from Europe, where he has gone to consult with the European capitalists interested in the undertaking. The cable can be manufactured either in England or in New York, and when completed it is claimed that a steamer like the *Faraday* can lay it in about a month, with favourable weather. When laid it will furnish the only opposition to the present consolidated cable company, whose rates were recently advanced from 25 to 50 cents a word.

Scott's Elevated Wireway.—According to the *Electrician* of New York, this invention consists of a system of housetop cupolas, one on each block, connected with each other by rigid or flexible waterproof tubes, through which common paraffined office wire (say number 18 or 20) can be drawn at will.

Each cupola has a tube connecting it with each of its four neighbouring cupolas. Every block is thus connected with the neighbouring blocks, and through them with every other block in the system, and a wire can be run from any cupola to any other without leaving the tubes.

The wires coming into the cupolas from the tubes are led to cheap connecting screws, where they are connected with those going out through the other tubes. Any wire can, therefore, be interchanged or "patched" if it is found faulty in any section. Wherever a tube crosses a street it is supported by a strong wire that will prevent it sagging. The tubes can be safely stowed away on the housetops without interfering with the comfort of the tenants, and will not be nearly so much in the way as the wires now are.

The paraffined wires may be drawn through the tubes from one cupola to another, either singly or in groups of ten or more at a time, as may be most convenient. Wires lying loosely in this way are affected less by induction than when they all run exactly parallel, as in a cable.

In establishing a new line in a system of this kind the wire is led from its starting point, through the various tubes and cupolas, in the most convenient direction, till it reaches the cupola of the block where it terminates; it is then led from its connecting screw, out at the top of the cupola, through an insulated block, and thence to the roof of the building it must enter.

High Electrical Science at the Academy of Sciences.—The *Comptes Rendus* of the Academy of Sciences of Paris for July 31st contain a somewhat interesting communication, the title of which is in itself a revelation. M. Yves Machai has contributed a note on "Some Theorems of Electricity Inaccurately Demonstrated in Works of Instruction." In this note the writer asserts that errors occur not only in the demonstration but also in the result of a theorem given by M. Mascart in his "Lessons on Electricity and Magnetism," a theorem which establishes a relation between the electric potential at a certain point and the surfaces on a level with it. M. Machai also discusses the demonstration of a theorem given by Clerk Maxwell and the accuracy of a theorem of Earnshaw considered correct by Clerk Maxwell and M. Mascart. M. Machai's conclusion is as follows :—"I could point out other similar instances, but I think I have shown sufficiently by the above examples what attention should be given to the reading of works by even eminent scientific men." The accusation made by M. Machai against the Academy of Sciences is a serious one, and it is not for us to decide upon its truth. It is probable that the question is not at an end, and that M. Mascart will reply. We shall not fail to follow it up.

Dangers from Lightning at Sea and on Land.—There is no reason whatever, says the *Colonies and India*, why every prominent building should not be supplied with one or more perfectly constructed lightning-conductors; and there does not seem to be any reason why ships at sea should not be similarly protected. An iron vessel, and particularly a steamer, which is practically a huge magnet, is especially liable to be struck by lightning, offering as it does a prominent "mark" on the waste of waters; and the accounts which we receive from time to time of ships being struck by lightning at sea suggest a very possible cause of those mysterious disappearances of ships which every now and then are reported. Possibly the cost of lightning-conductors is higher than the average risk of a house justifies the builder in incurring, but if the demand were larger the price would no doubt be reduced.

"The Bewildering Higgs."—This is the title of a smartly-written article in the *New York Times* of June 16th, concerning the peccadilloes of a gentleman formerly resident in London and in the employ of Messrs. Siemens Brothers. It will be remembered that this firm parted with him in consequence of very suspicious circumstances and after legal proceedings against him had been taken. We purpose dealing with this matter more fully in our next.

City and Guilds of London Technological Examinations.—We have received the following list of students

who were successful in the examination in electrical engineering at the above examinations. They were all educated at the College of Science and Arts, Glasgow. We may mention that the total number of successes for the kingdom in electric lighting was twenty-seven. (*See* ELECTRICAL REVIEW for 5th of August.)

(I certify that the following is correct.

JOHN M. M'CURRICH,
Hon. Sec. Science Classes, College of Science and Arts.)

Mr. James Livingston is one of the four taking 1st class in honours, and Mr. Crawford is third in the ordinary stage for electric lighting, and gains the bronze medal.

TELEGRAPHY.

Name of Candidate.	Occupation.	Age.	Subject.	Grade.	Class.
Livingston, Jas...	Telegraphist.........	28	Telegraphy ...	Hon.	1
Wilkes, G. S. ...	P. O. Telegraphist.	30	,,	Ord.	2

ELECTRICAL ENGINEERING.

Name of Candidate.	Occupation.	Age.	Subject.	Grade.	Class.
Crawford, Jas. ...	Elect. Eng. Stud...	25	Elect. Lighting	Ord.	1
Arnot, Nigel......	Elect. Light Eng...	25	,,	,,	1
Watkinson, Wm.	,,	21	,,	,,	1
Carswell, T.	Elect. Eng. Stud...	21	,,	,,	2
Conner, B..........	,,	16	,,	,,	2
Downs, Alex......	,,	33	,,	,,	2
M'Ewen, H.	,,	17	,,	,,	2
M'Culloch, N...	,,	16	,,	,,	2
Miller, J. D., jun.	Telephonist	18	,,	,,	2
Pinkerton, R.......	Elect. Eng. Stud...	46	,,	,,	2
Richardson, R....	Electrician	15	,,	,,	2
Robertson, G. jun.	Elect. Eng. Stud...	21	,,	,,	2
Ross, Wm..........	,,	26	,,	,,	2
Smith, D. C.......	Electrician	22	,,	,,	2
Turnbull, W.......	Elect. Eng. Stud...	18	,,	,,	2
Wright, P., jun...	,,	17	,,	,,	2

ON PERRY'S AND AYRTON'S METALLIC GALVANIC BATTERY.—By B. J. Goossens.—According to Perry and Ayrton, a galvanic combination may be obtained by plunging plates of platinum and magnesium into mercury. According to them, this is not the case if other metals, *e.g.*, zinc, are used, because the impurity and great conductivity of zinc, combined with the great liquidity of the amalgam, cause the energy available for the production of a current from the zinc to the non-amalgamable metal to be extremely small. The magnesium amalgam is solid, and the above-mentioned physicists obtained with this element a maximum electromotive force of 1·56 volts. = about 1·5 Daniell as measured with the electrometer.

The experiments of Obach (*Pogg. Ann.*, Ergänzungsband, 1876, p. 300) are in complete contradiction with this result; currents are, indeed, obtained also on the amalgamation of zinc, but these are true thermic currents, which owe their origin to the changes of temperature depending on amalgamation.

Obach, however, did not experiment with magnesium, and, as the subject is of great theoretical importance, the author resolved to repeat the experiments with this metal.

For measuring the current he employed a Thomson mirror-galvanometer, which, with an iron-copper element and slight resistance, gave an indication of 25° of its scale for a change of temperature of 0·1° C.

The mercury was purified with diluted nitric and concentrated sulphuric acid, and was afterwards repeatedly washed with distilled water and carefully dried.

This mercury was placed in a U tube fitted with an enlargement at the top on either side, for the reception of a small plate of platinum, and on the opposite side one of magnesium. The platinum was left permanently in the mercury, and the magnesium was fixed in a wooden slide, by which it could be let down into the mercury. Into the wide parts of the tube there were plunged near, respectively, to the platinum and the magnesium two soldered points of a thermo element, in order to permit the course of the changes of temperature to be observed. The thermo element consisted of an iron wire, to the end of which were soldered copper wires, and it was insulated from the mercury by a coating of lac-varnish.

In order to eliminate possible changes of temperature from external influences, the glass tube was folded round with cotton and placed in a wooden box, and all the points of contact were likewise wrapped in cotton. The experiments were performed in a room not artificially heated. The copper connection wires, coated with silk, were led to a mercury tilt, in order to convey the current of the magnesium-mercury-iron element and of the thermo element through the galvanometer in rapid succession.

As soon as the thermo-element indicated no current and the mercury in both limbs of the tube indicated, consequently, the same temperature, the magnesium was let down into the mercury.

The first deviation of the needle of the galvanometer was not always in the same direction, which may be due to a slight difference of temperature between the magnesium and the mercury. In a few minutes the deviation was always in the same direction, indicating a current from the mercury to the magnesium, consequently a heating current (Wiedemann's "Galvanismus," I. p. 810) increasing rapidly at first, then remaining for a length of time almost constant, and finally decreasing a little. The thermo-element indicated at the same time a heating of the mercury near the magnesium, and its current showed the same changes as the other.

The values obtained in the numerous experiments were not all of equal magnitude, but were all in the same direction. A single example will suffice to show the cause of the experiments:—

Galvanometer Deviations.

Magn. El.......	10	20	40	45	60	80	100
Therm. El.......	100	160	200	240	280	320	370

Half an hour later :—

Magn. El.......250. Therm. El.......700.

From the direction of the current and from the observed rise of temperature, it may be concluded that the current obtained on the amalgamation of magnesium as well as Obach's amalgamation currents is a true thermic current, and has its cause in the rise of temperature accompanying the formation of the magnesium amalgam.

If magnesium and platinum are placed in one vessel near each other a current is observed which at first quickly increases, but then again decreases in consequence of the progressive heating of the platinum, and because magnesium has a place intermediate between mercury and platinum in the thermo electric series.

The following deviations of the needle were obtained at successive intervals of a quarter of an hour : 10, 120, 120, 100, 80.—*Wiedemann's Annalen.*

ON LIGHTNING CONDUCTORS.—By M. Melsens.—I propose to reply on a future occasion in a complete manner to the various objections raised against my system of lightning conductors. I will, in particular, discuss the opinion which sees danger in the use of a sort of cage formed of multiple conductors, among which some persons seem to fear the production of sparks of electrostatic induction. I will merely for the present recall an experiment which seems to me decisive, and which has been thus regarded by many physicists. This experiment supports those of Faraday, which prove that no electric manifestation is possible in a cage with continuous metallic sides, or of metallic network placed in perfect communication with one common reservoir.

Any small animal, such as a rabbit, &c., is placed in a hollow globe of metallic network placed upon the coating, or suspended from a powerful Leyden battery. The attempt was then made to strike the animal by the discharge. But far from being struck down the animal did not experience any action from a spark which would have been dangerous or even mortal but for the protection of the metallic cage.

The cage represents my lightning conductor, and the animal enclosed represents a house with its inhabitants, and the combustible matter which it may contain. I remark, further, that my conductor is fitted with numerous points, which certainly have not the property of provoking electric manifestations in the interior of a metallic cage, especially if it is in perfect connection with the moist earth, or with large metallic surfaces, or in a town with the water and gas pipes.—*Comptes Rendus.*

"On Singing Condensers."—By W. Holtz.—In view of the attention which has been latterly given to the so-called singing condensers, I remark that as far back as 1875 (*Annalen*, 1875, p. 496), I made mention of a similar phenomenon, which, however, remained unnoticed. I observed it in hollow metallic discs, which I used as the electrodes of an influence machine, on bringing them so near that sparks struck across between them. I remarked then that on gradual approximation the tone did not become continually, higher but occasionally ceased entirely, because the dimension of the disc could not correspond to every height of tone, and that this is the best proof that the sound in question is not merely the sound of discharges, which may be also proved by transferring the latter to a distance. Whoever wishes to repeat the experiment, for which a single disc suffices, placed opposite a large globe, will proceed most correctly, in order to vary the approximation and the length of sparks independently of each other, if he allows the sparks to strike from one discharging rod to one of the sliding cylinders of the well-known intercalatory apparatus. With a certain succession of sparks and at a certain approximation the disc sings more distinctly, but it can sing at very different heights. Generally we hear simultaneously several and indeed disharmonic tones, such as may be heard in vibrating plates. Leyden jars must be first removed.—*Wiedemann's Annalen.*

On Double Refraction in Glass and Sulphuret of Carbon occasioned by Electric Influence.—By H. Brongersma.—The author has re-examined the phenomena first observed and described by Kerr in his memoirs on "A New Relation between Electricity and Light" (*Phil. Mag.*, 1875, p. 337), chiefly because certain physicists have failed to obtain the same phenomena as far as solid bodies are concerned. He found, however, that the doubts as to the correctness of Kerr's results are unfounded. If explanations based upon the supposition that electricity produces these phenomena in an indirect manner are not confirmed by an experimental examination, it becomes more and more probable that we have here to do with a hitherto unknown action of electricity upon the luminous vibrations.—*Wiedemann's Annalen.*

A Galvanic Element.—By Kuhlo.—The earthenware cylinder of a Daniell's element is replaced by a tube of parchment paper, which is fixed by means of india-rubber rings to a cylindrical frame of an insulating material consisting of a bottom plate and superimposed rods, connected above.—*Electrotechn. Zeitschrift.*

Chromic Acid Elements.—The zinc plate is laid on the bottom of the cell, or preferably zinc amalgam is put into a shallow beaker, as the solutions of chrome, alum, and sulphate of zinc, being heavier, sink to the bottom and do not attack the zinc.—*Wiedemann's Beiblätter.*

NEW COMPANY REGISTERED.

Patent Electric Gas Igniting Company (Limited).—Capital £100,000 in £5 shares. Objects:—To manufacture Clarke's patent electric lamp and apparatus and appliances for the lighting of gas by electricity or for the generation, accumulation, or transmission of electricity either as a motor, igniting or lighting power; also to acquire the properties and liabilities of the Electric Gas Lighting Company (Limited) and of the London and Provincial Electric Gas Lighting Company (Limited). Signatories (with one share each): Sir R. W. Rawson, 68, Cromwell Gardens; Francis Bennoch, F.S.A., 5, Tavistock Square; S. F. Porter, Putney; J. Leigh and William Milne, Alderley Edge, Cheshire; J. H. Stretton, 2, Dean Street, Park Lane; J. A. Hilliard, Grove Park, Kent. The signatories are to appoint the first directors. Remuneration: Chairman, £300 per annum; deputy chairman, £200 per annum; ordinary directors, £150 per annum each. The members of the board will also be entitled to a commission of 1 per cent. upon the amounts received from the sale of foreign patents, and after 2½ per cent. of the net profits remaining after payment of 10 per cent. to the shareholders. Registered 2nd inst. by Newman & Co., 75, Cornhill.

NEW PATENTS—1882.

3698. "Micro-telephonic apparatus." J. H. Johnson. (Communicated by A. D'Arsonval.) Dated August 3.

3700. "Secondary batteries." E. G. Brewer. (Communicated by O. Schulz.) Dated August 3.

3705. "An improved construction of electric lamp." J. L. Somoff. Dated August 4.

3710. "Improvements in electric lighting and in apparatus connected therewith." T. Parker and P. B. Elwell. Dated August 4.

3712. "Construction and arrangement of the cores and armatures and other parts of electro-magnets." S. C. C. Currie. Dated August 4.

3713. "Electric arc lamps." E. G. Brewer. (Communicated by Société Anonyme des Ateliers de Construction Mécanique et d'Appareils Electriques.) Dated August 4.

3751. "Electrical signalling apparatus for railway or other purposes." W. R. Lake. (Communicated by G. W. and A. D. Blodgett.) Dated August 5.

3752. "Means employed in or for transmitting electricity for light, power and other purposes." T. J. Handford. (Communicated by T. A. Edison.) Dated August 5.

3753. "An improved combined holder and switch for incandescent electric lamps." C. E. Sibley. Dated August 5.

3755. "Electrical meters." T. J. Handford. (Communicated by T. A. Edison.) Dated August 5.

3756. "Dynamo or magneto-electric machines." T. J. Handford. (Communicated by T. A. Edison.) Dated August 5.

3757. "Improvements in the manufacture of light emitting conductors for electric lighting purposes and in apparatus therefor, which apparatus is also applicable for other purposes." R. Werdermann. Dated August 5.

3762. "Apparatus for utilising the force of fluids, air, and water (producing electric currents)." E. E. H. Rousseau. Dated August 8. (*Complete.*)

3763. "Telephones." J. J. Barrier and F. F. de Laverrède. Dated August 8.

3770. "Preparation of lead for use in the cells of secondary batteries." L. Epstein. Dated August 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

5286. "Production of the electric light, &c." A. R. Sennett. Dated December 3. 6d. Has for its object improvements relating to the production of the electric light, more especially with reference to that system in which it is obtained by the incandescence of a continuous conductor enclosed in a vacuous receiver. Firstly, in the preparation and production of a conductor more uniform in its specific electrical resistance, and better adapted to withstand the very high temperature to which it must necessarily be subjected, and to the disintegrating action of the residual gas of the receiver. Secondly, in the method of compressing and compacting the same so as to render it extremely dense and imporous. Thirdly, in the method of carbonising the same. Fourthly, in the method of mounting the same. Fifthly, in the method of eliminating the atmospheric air from the receiver. Sixthly, in the method of making the joint between the material of the receiver and of the conductors. To obtain these objects the inventor reduces any material sufficiently pure, and containing a high percentage of cellulose, to a finely divided, jelly-like state or pulp (either fibrous or otherwise) by chemicals, or other means. In this condition the whole of the impurities so detrimental to the durability of the conductor can most conveniently be removed by the usual chemical means; from this are formed by moulding, or other operation, the required conductors. In order to produce the requisite hardness and compactness, the inventor moulds or forms the conductor under great pressure, whilst to insure its imporosity this operation is caused to take place (very slowly) in a vessel from which the air is being constantly exhausted.

5367. "Machine for coating insulated electrical conductors with lead." W. R. Lake. (A communication from abroad by Hiram Stevens Maxin, of Brooklyn, America.) Dated December 8. 6d. Relates to a machine for covering insulated wires with lead. (*Provisional only.*)

5396. "Electric lamps." C. F. Varley and F. H. Varley. Dated December 9. 6d. Consists mainly as follows:—A hollow cylinder of sufficient length to hold the carbon rod is provided with a spiral spring or propelling weight, for the purpose of feeding the carbons. At or near the feeding end or cap of the cylinder is a roller contact-clutch, which is made to be adaptable for varying diameters of carbon rod, and through which the current is conveyed to the carbons. In one arrangement an insulated swing arm is used, fixed into the cap, which carries a fixed opposite carbon pole. To charge this lamp the swing arm is moved on one side. The carbon rod or candle is inserted through the roller contact-clutch, and forced into the socket attached to the lower, or remote end, of the spiral spring, and this forces back the spring to the length of the carbon to be used. The roller clutch is provided with a magnetic regulator, for determining the length of the arc.

5524. "Electric lamps, &c." Rankin Kennedy. Dated December 17. 8d. Relates to both incandescent and arc electric lamps, and its objects are principally to facilitate the manufacture, to render

certain parts or connections more satisfactory and durable than as hitherto made, and to obtain an improved automatic regulation. Figs. 1 and 2 show the improvements in arc lamps in which the length of the arc and the movements of the carbons are regulated by means of the lamp current passing through the solenoid, *a*, as shown, thereby acting magnetically, as is well understood, upon the core, *c*, which is connected to the crossbar, *d*. This crossbar, *d*, carries at its ends the pawls, *e*, *e*, and is at the same place coupled to the pawl levers, *f*, *f*, by pins, *n*, *n*, which pass through holes in the crossbar, *d*, pawls, *e*, *e*, and pawl levers, *f*, *f*, the latter being mounted at their outer ends upon the axes, *g*, *g*, which also carry the ratchet pulleys, *h*, *h*. The upper carbon is attached to the core, *c*, of the solenoid, *a*; and the lower carbon, D, is attached to the carbon holder, B, which is suspended by cords, *i*, *i*, passing over the ratchet pulleys, *h*, *h*, and is kept in proper working position by the antifriction rollers, *k*, *k*,

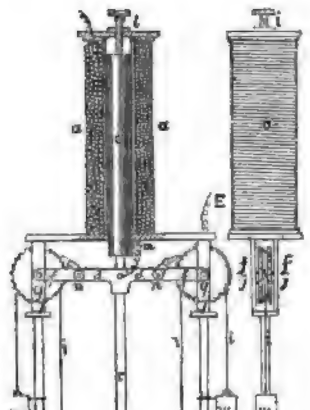


FIG. 1. FIG. 2.

bearing against the upright bars of the framing, *j*. When the lamp is put into circuit the current passes through the solenoid, *a*, thence through the wire, *m*, to the upper carbon, C, and from this the current passes across a space occupied by the arc to the lower carbon, D, which is not insulated from its carrier, thence to the return wire, E, through the metallic connections formed by the rollers, *k*, *k*, and the framing, *j*. When the current passing through the solenoid, *a*, is of less than the proper strength, the solenoid core, *c*, descends, and at the same time releases the pulleys, *h*, *h*, so that the carrier, B, and the lower carbon, D, rise, while at the same time the upper carbon descends. This shortens the arc, and allows a greater quantity of current to pass; the solenoid then draws up the core, *c*, and thus checks the pulleys, *h*, *h*. An adjustable screw stop, *l*, is fitted at the upper end of the solenoid, *a*, so that the raising action of the core is limited to give the precise length of the arc described.

5577. "Electric telegraphs." SIR JAMES ANDERSON and BENJAMIN SMITH. Dated December 20. 6d. Has for its object improvements in electric telegraphs, and relates more especially to the means of and apparatus for retransmitting or "translating" telegrams from one telegraph cable or telegraph line to another. The improvements render fewer the operators to be employed and expedite the transmission of telegrams.

According to this invention one set of instruments can be employed, one key and one recorder for the two cables, and for this purpose the inventors employ a novel switch having a lever handle which has three positions. In the central position of the handle both cables (or the condensers into which the cables work, if such be employed, as is usual) are connected through the recorder to earth, and in this position a call signal sent through either cable is received upon the paper of the recorder. When the handle is moved to either side one cable remains connected with the recorder, whilst the other becomes connected with the key and through the key with the battery. The operator then on receiving a call moves the handle over from the central position to that side which leaves the calling station connected with the recorder, and as the telegram comes in he reads it from the paper of the recorder and retransmits it by means of the key into the other cable. When the handle of the switch is moved over to the other side the connections are reversed and become suitable for working in the opposite direction through the cables. The same movement of the handle alters the battery from what is suitable for one cable to that which the other cable requires.

5601. "Electrical brushes and combs." J. N. ARONSON. Dated December 21. 6d. Relates to electrical brushes and combs for the application of currents of electricity to the skin of the head and roots of the hair, for promoting the growth of the hair and for curative and remedial purposes. The invention relates to the combination with a brush or comb constructed for the transmission of electric currents to the skin and roots of the hair, of an induction coil and battery for the generation of the currents, and to the peculiar construction of the brush and comb for the purposes above mentioned.

5618. "Holder for incandescent electric lights." DAVID GRAHAM. Dated December 22. 6d. Relates to a new or improved holder for incandescent electric lights, and consists of a piece of insulating material, in the one end of which a screw thread is cut, or a screwed bush may be placed thereon, in order to attach the holder on to the screw of an ordinary burner socket of a gas bracket or gasalier. This block or plate of insulating material has placed on it a spring, or elastic socket, for holding the parallel or tubular part of the glass chamber of an incandescent light. The spring, or elastic holder, is made in two portions, insulated from each other. Into each portion a pinching screw passes, which, when the lamp is placed in its socket, bear upon the two metallic tongues leading and joined to the platinum or other wires to which the carbon is joined. Thus these pinching screws form electrical connection between the outside metallic portions of the holder and the interior of the lamp, so that by their means when a current is passed through the holder it is transmitted by the pinching screws to the lamp conductors. The holder may be provided with a switch or an equivalent apparatus for making and breaking contact. Electrical connection with the light holder is made by passing the wires of a circuit by preference, for the sake of convenience and neatness, through the tube of a gas bracket or gasalier out through openings formed in the side of the nozzle or gas burner socket, these wires being insulated from the metal of the socket.

5639. "Electrical alarm apparatus for railway trains." DOTTORE SALVATORE GARAU. Dated December 23. 6d. Has for its object improvements in electrical alarm apparatus for railway trains, to enable passengers to give an alarm to the guard or driver in case of necessity. For this purpose the inventor provides at each end of each carriage of a railway train, in addition to its ordinary buffers, two other insulated metallic buffers pressed outwards by springs to a distance somewhat exceeding that to which the ordinary buffers are pressed out, so that when a train is made up the metallic insulated buffers are of necessity brought into contact with one another. The insulated buffer at one end of each carriage is coupled by an insulated wire with one of the buffers at the opposite end of the carriage, and similarly couple together the other two buffers. At any desired number of points at the sides and ends of the carriages are affixed a series of contact apparatus so constructed that by the pulling out or pushing in of a stop an electrical contact may be established between the two terminals of a contact apparatus to which the stop belongs. One of the terminals of each contact apparatus is connected by a wire with one of the wires connecting two of the insulated buffers, and the other terminal with the other wires connecting the two other buffers.

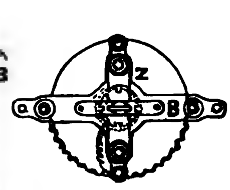
5651. "Electric current meters." ST. GEORGE LANE FOX. Dated December 24. 6d. Has reference to improvements in electric-current meters, and especially to that class of apparatus described in the specification of former letters patent granted and dated November 14, 1878, No. 4626, in which apparatus the position or motion of an armature due to the amount of current passing through a corresponding electro-magnet, controls the working of the clockwork or mechanism of a counting apparatus. One part of this invention consists in the employment of a magneto-electric motor to give a constant motion to a certain shaft in the meter—the inventor uses a horizontal shaft free to oscillate about a vertical axis passing through its centre; at the ends of this shaft are placed two armatures, each opposite an electro-magnet; or there may be only one armature and a corresponding electro-magnet. It is arranged that these magnets (when there are two) are put into action alternately by springs which make contact according to the position of the shaft, and by properly balancing and weighting the shaft perfectly regular oscillations are obtained. An auxiliary spring is employed in connection with the shaft so as to insure one of the connections being made when the instrument is at rest, so that it may start directly any current flows.

5656. "Apparatus for working electric clocks, &c." E. G. BREWER. (A communication from abroad by C. E. Buell, of America.) Dated December 24. 8d. The object of the first part of this invention is to dispense with the use of local batteries as ordinarily used at the sub-stations of a line used for controlling electric clocks, and to this end is devised a certain combination of a relay in a constantly closed main-line circuit with a secondary battery in a derived circuit, together with a clock to be operated by the battery in such circuit, the whole being combined with an electro-magnetic switch controlled by the relay in the main-line circuit in such a way that in one position of the switch the secondary battery is charged by the current flowing through the main-line, while in the other position of the switch the derived current from the main-line is broken, and the current of the secondary battery is closed locally through the operating or controlling electro-magnet of the electric clock. By this combination of apparatus the clock can be operated with certainty and at the same time dispense with the use of local galvanic batteries ordinarily employed in conjunction with relays in the main-line circuit. The object of the second part of this invention is to operate fire-alarm signal apparatus upon the same circuit with electric clock apparatus in such a way that the operation of signalling by the fire-alarm devices shall not interfere with the correct transmission of the impulses which control the clocks, while *vice versâ* the operation of controlling the clocks at sub-stations from the standard clock at a central or terminal station shall not at any time prevent the transmission of the fire-alarm signals. The object of the third part of the invention is to so combine the apparatus for sending the controlling impulses for electric clocks, and telephone indicating and signalling apparatus, that the two systems may be used upon the same line without interference with one another.

5660. "Electric lamps." L. S. POWELL. (A communication from abroad by J. M. A. Gérard-Lescuyer, of Paris.) Dated December

24. 6d. Relates to electric lamps and it consists in certain improvements in the construction and arrangement with the apparatus for automatically operating and regulating the feed of the carbons employed to produce the voltaic arc as hereinafter described. Figs. 1, 2, 3, and 4 represent a lamp worked by alternate currents to which the invention is applied, the said figures representing respectively a vertical section, a side elevation, a plan, and a horizontal section of the said lamp. This apparatus operates as follows:—Before lighting the lamp the carbons are separated, so that the current being unable to pass along the carbons is entirely diverted into the shunt or coil of the electro-magnet, which thus becomes excited and attracts the two armatures, O and T. The attraction exerted on the upper armature, T, has the effect of drawing down the short vertical rods, S, and thus opens the claws, U, causing them to release the upper carbon holder, which thereupon slips down very slowly, its descent being retarded by

Fig. 3.



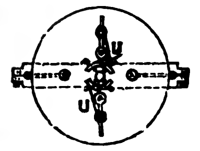


Fig. 4.

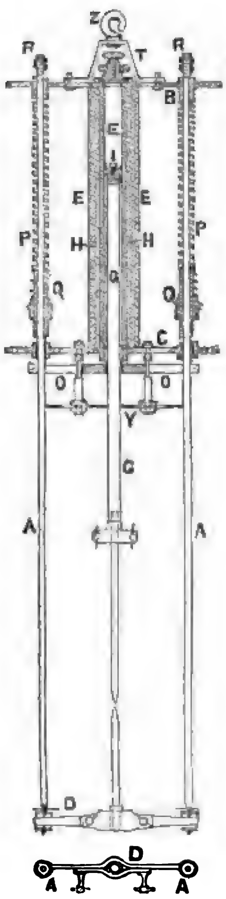


Fig. 1.

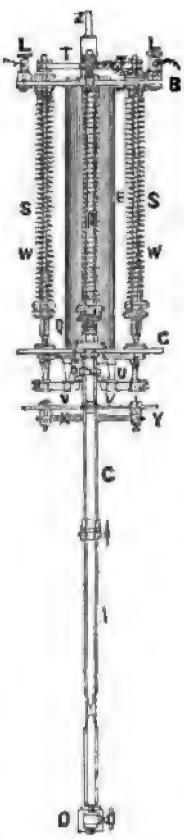


Fig. 2.

the partial vacuum produced behind the piston, I. The rate at which the carbon descends may thus be controlled by adjusting, by means of the valve, the rate at which air is allowed to pass into the tube, F, above the said piston, I. The lower armature, O, is also attracted by the electro-magnet at the same time that the upper armature is attracted and in such a manner as to draw up the rods, A, connected with the lower carbon holder, D. When the carbons are brought into contact the current passes through them almost exclusively, so that the electro-magnet, E, is demagnetised. The armature, T, connected by the rods, S, with the claws of the brake is then raised by the helical springs, W, around the said rods, and the claws, U, again clasp the upper carbon holder, whilst at the same time the lower carbon holder is also released and allowed to drop by its own weight for a distance regulated by the nuts or stops, B, on the rods, A, thus establishing the arc. When the resistance at the arc becomes excessive the power of the current in the coil of the electro-magnet, E, is increased, whereupon the armatures are again attracted and the carbons are brought together as hereinbefore described.

5661. "Pipes for containing electrical conductors." J. H. Johnson. (A communication from abroad by Clément Labye and Léon de Locht-Labye, both of Paris.) Dated December 24. 6d. Relates to pipes or conduits for containing electrical conductors or wires, and it consists of an improved method of arranging and enclosing the said conductors or wires in a conduit or chamber constructed with a removable cover. This conduit is first placed in position in the ground, after which the wires are arranged in its interior in layers being imbedded in asphalte or other suitable insulating material, are further protected from injury by a cover which is subsequently attached to the conduit. (*Provisional only.*)

5665. "Apparatus for producing and regulating electric light, &c." S. A. Varley. Dated December 24. 10d. Has for its object ents in apparatus for producing and regulating electric roducing electric light it is desirable the electricity pro- ld be as nearly as possible of uniform potential, and there- he light circuit should be of as nearly as practicable constant fault common to dynamo-electric machines is that the electricity developed by them even under favourable conditions is of a more or less undulating potential. Now by the present invention this defect is reduced and the electricity developed is made to automatically regulate its production and also to regulate the resistance of the light circuit. To this end the inventor constructs a number of wheels which he terms the "armature wheels;" the periphery of each of these wheels consists of an even number of iron blocks magnetically insulated from one another, which blocks are called the "bobbin armatures." These armatures are grooved out in the centre to receive the bobbin magnets and when completed present a nearly continuous surface of iron to the field magnets. B (fig. 1) represents one of the armature wheels; its periphery consists of an even number of blocks of iron, A, having notches or grooves, A×, cut in them. These blocks are magnetically insulated from one another by the teeth or projections, A^2, and are mounted on the wheel, B, which is constructed of a suitable non-magnetic metal, to which they (the blocks) are brazed, or soldered, or attached by other suitable means. These armature wheels are mounted, at equal distances from one another, on the axle, A××, of the machine, as shown in fig. 2. Soft iron bobbin magnets, C, wrapped with coils or bobbins of insulated wire, C, fit into the notches of the blocks of iron, A. The armature wheels are mounted on an axle at equal distances from one another, the recesses in the armature blocks being arranged in a line with the axle, the bobbin magnets fit into these recesses, and it is preferred to construct them of a number of thin plates of iron arranged side by side magnetically insulated from one another by pieces of paper or other suitable insulating material placed between the plates. Fig. 3 is a front view, and fig. 4 is an end view of one of the bobbin magnets, C, and one set of bobbins, C^1. The bobbin magnets are wrapped with insulated wire in the spaces between the armature wheels, which

FIG 1

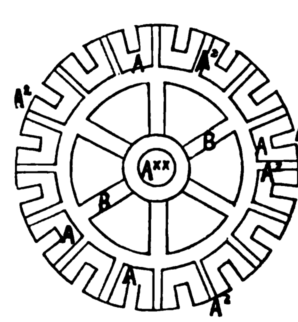


FIG 2

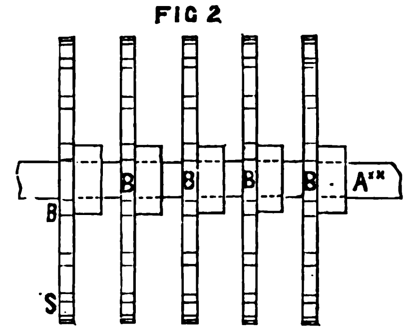


FIG 4 FIG 3

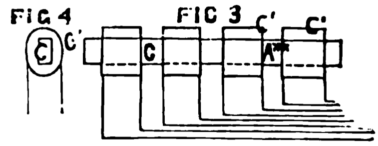
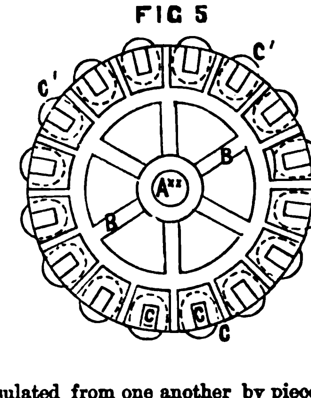


FIG 5



wheels divide them into sections. Fig. 5 is an end view of the armature wheels, with the armature blocks, bobbin magnets, and bobbins mounted in their places.

5667. "Collection and distribution of electric currents." S. A. VARLEY. Dated December 24. 6d. According to this invention the inventor causes the contact poles of the dynamo machines to move in contact with the insulated segments connected to the armature coils with a rolling friction and he imparts to the poles a motion of rotation equal to or slightly greater or slighly less in circumferential velocity than the motion of the insulated segments.

5674. "Transmitting and receiving apparatus for type-printing telegraphs." SYDNEY PITT. (A communication from abroad by Henry Van Hoevenbergh, of America.) Dated December 27. 10d. Relates to type-printing telegraphs in which the type wheels of the receiving instruments are impelled by a weight or spring acting through suitable intermediate wheel-work, and the progressive movements of said type-wheels are controlled by a series of electrical pulsations alternately of opposite polarity, which are transmitted over the main line from the sending station. These pulsations cause the rapid to-and-fro vibration between electro-magnets of an armature, suitably constructed to be actuated by such alternating currents and the vibrating in turn controls the type wheel, by means of a step-by-step escapement, of well-known construction. In the improved apparatus the printing is effected by increasing the strength of the electric current during some one of the pulsations, without reference to its polarity, at the instant the required division or character of the type wheel is opposite the platen, and this action takes place without retarding the progressive movement of the type wheel, or interrupting the regular succession of electric pulsations. The momentary stoppage of the type wheel shaft at the termination of each vibration of the step-by-step escapement affords sufficient time to permit an impression to be taken from the type wheel by means of proper mechanism.

5681. "Construction and arrangement of dynamo-electric machines." J. RICHARDSON. Dated December 27. 4d. Relates mainly to a particular construction and arrangement of armatures in couples or pairs capable of augmentation in connection with field magnets to produce a constant electrical current of uniform intensity. For the purposes of the invention the inventor arranges a series of two armatures at right angles to each other, and so fitted in connection with field magnets that one is at the point of maximum when the other is at the point of minimum intensity, and as one increases in intensity in the same ratio the other diminishes the sum of the two will produce a constant intensity of current. Six pairs of these armatures with their corresponding field magnets are preferably arranged in the same machine, and it is evident that any number from one pair upwards can be used with an augmentation in electricity according to the number used, and that all can be "coupled up" to two contact pieces on the commutator overlapping each other by one-fourth of its circumference, or, if necessary, two commutators could be used and three pairs of armatures coupled to one and three pairs to the other, their axes being at an angle of 45° with the others, if such an arrangement was necessary, to produce still greater uniformity of current. This system of construction and arrangement also possesses the advantage of simplicity of manufacture, a great variety of sizes of machine being possible to be made from the same patterns simply by lengthening the bed plate and coupling together greater numbers. All the winding can be done by machinery, thus economising labour, and the armatures can be coupled together for either quantity or intensity as may be required, also either one or all the pairs can be used to excite the field magnets according to the strength required in them.

5687. "Controlling and regulating the production and distribution of electricity." C. A. CARUS-WILSON. Dated December 27. 8d. Has reference to means or apparatus for controlling and regulating the production and distribution of electricity. One part of the invention consists in a method of acting upon the generating machine, water, steam, gas, or other engine in addition to the ordinary governor; the inventor permits the governor to regulate the motion of the engine in the usual way, but supplements its action so that it regulates the cut off with respect to the electromotive force produced. The manner in which this may be effected is as follows:—The inventor arranges that a force, preferably a weight, shall be brought to bear upon the governor as it rotates, and that this force shall be under the control of two electro-magnets, one to apply the force and another to take it off. These magnets are respectively brought into action by currents whose circuit is made and broken by a galvanometer needle. When the engine is producing the desired electromotive force, the galvanometer needle is stationary between two stops, a short way apart, the weight or other force meanwhile keeping the governor down a little, and when the electromotive force rises the needle is deflected against one of the stops, making circuit through one of the magnets, and this will alter the force on the governor, causing a decrease of speed and hence a decrease of electromotive force. On the other hand, if the electromotive force fall, the needle will touch the other stop, and thereby cause the other magnet to act and the weight or other force to be applied to the governor in the other direction, which will increase the electromotive force.

5702. "Sockets or holders for electric lamps." J. W. SWAN. Dated December 28. 6d. Relates to improvements in sockets or holders for electric lamps, whereby a lamp without any external fittings can be readily attached to the conducting wire and a good contact between them and the terminal hooks or eyes of the lamp can be effected and maintained. In carrying out the invention the holder is provided with two hooks or equivalent devices insulated from each other and terminating in binding screws or contact pieces on opposite sides of the holder or suitably arranged for making concentric contacts by the act of screwing the holder to the lamp bracket or other support for the lamp. In either case contact between the lamp and the lamp socket or holder is effected by engaging the two hooks or their equivalents belonging to the socket with the two eyes or other counterpart devices which constitute the terminal conductors of the lamp. Firm contact between the hooks and the eyes or their equivalents of the lamp and socket is produced by the action of a spring placed in compression or in tension by the act of making the connection between the lamp and its socket or by the act of screwing or sliding towards the lamp an external tube so that an outward pressure may be exerted upon the lamp tending to put the hooks and eyes or their equivalents into tension and thus effecting and maintaining a good electrical contact.

5738. "Electric lamps." J. G. LORRAIN. Dated December 31. 4d. Relates to improvements in incandescent and other electric lamps, and has for its object diffusing the light and economising the same by preventing its radiation in directions where its effects are not required and of concentrating the light in a required direction and also rendering it more pleasant to the eye, and the invention consists in silvering or coating with a reflecting material a portion or portions of the bulb or globe of the lamp in such a manner as to produce the effects before mentioned.

5743. "Electrical resistances." GUSTAV PFANNKUCHE and R. E. DUNSTON. Dated December 31. 6d. Relates to certain improvements in the construction of electrical resistances. On account of the heat developed in the resistance coils or boxes as at present existing these arrangements are exceedingly bulky, unhandy and expensive, and it is obvious that it is possible to use wires or other materials of very high resistance and at the same time make provision for uniformly distributing and carrying away the heat developed in these wires or other materials a very efficient and handy and cheap resistance apparatus can be produced. To effect this the inventors propose to use wires or other suitable materials of high resistance and of a size proportional to the required amount of resistance and to embed or envelop the same in a mass of a bad conductor of electricity, such as glass or plaster of Paris or asbestos, or any other non-conducting mass, shaping the same in such a manner as to get as large as possible a cooling surface and to rapidly take up the heat developed in the resistance wires or other material, and thus preventing the resistance material from being destroyed or fused when a strong current is made to pass through it. It will be seen that in this manner comparatively very small wires or other materials can be used as resistances for large currents, thereby materially reducing the size and expense of such resistance apparatus.

5751. "Operating or controlling railway brakes by electricity." W. R. LAKE. (A communication from abroad by Augustus L. Duwelius, Leonard W. Goss, Paget Higgs, Frank R. Merrell, Hiram D. Peck, and Hugo Walter, all of America.) Dated December 31. 6d. Relates to the application of electricity for operating the brakes of railway trains, and embodies various improvements designed to render the same practicable and efficient. These improvements comprise the following features, that is to say—combining in such a manner as to be under the control of the engine-driver one or more generators of electricity with storage batteries or other electric accumulators and suitable connections with the brake actuating mechanism. A method or system for circuiting the electro-brake mechanism of a train of railway vehicles, consisting in the employment of main conductors attached in separable sections to each vehicle and forming, when connected, substantially continuous electric mains, with permanent cross connections at each vehicle in which the electro mechanism of the brakes is interposed. The construction and arrangement of electro-brake mechanism by which the electro-magnetic force is applied.

CITY NOTES.

OLD BROAD STREET.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

THE report of the directors ran as follows:—The total receipts from January 1st to June 30th, 1882, including a balance of £4,811 13s. brought over from the last account, amount to £208,750 1s. 7d. The traffic receipts show a decrease, as compared with the corresponding period of last year, of £94,349, consequent upon reduced rates.

The total expenses of the half-year, including income-tax and repair of cables, &c., as shown by the revenue account, amount to £58,166 1s. 10d.

The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £75,000 to the renewal fund, leaving an available balance of £75,583 19s. 9d.

One quarterly interim dividend of 5s. per cent. on the ordinary stock, and of 10s. per cent. on the preferred stock, free of income-tax, was paid on May 1st, 1882, absorbing £17,500, leaving a balance of £58,083 19s. 9d., from which a second quarterly dividend of 15s. per cent. on the ordinary stock, and of 30s. per cent. on the preferred stock, free of income-tax, will be paid on August 1st, 1882, leaving a balance of £5,583 19s. 9d. to be carried forward to the next account.

The cable laid by this company in 1874 was broken off the coast of Ireland on November 22nd, 1881; it was successfully repaired on February 5th last, and has since worked well.

The Brest-St. Pierre cable, laid in 1869, was broken in mid-ocean on March 18th last. The repairs have been intrusted to the Telegraph Construction and Maintenance Company, and, from the progress already made, the directors hope soon to be able to announce the restoration of communication by that cable.

The company's repairing ss. *Minia* has been engaged during the half-year in repairing the St. Pierre-Duxbury cable, laid in 1869, the Placentia-St. Pierre cable, laid in 1872, and the South Placentia cable, laid in 1873. The company's system of cables and land lines on the other side the Atlantic is now in good working order and condition.

The ordinary general half-yearly meeting of the company was held in the City Terminus Hotel, on Friday, the 4th inst., the Right Hon. Viscount Monck, chairman of the board, presiding.

The Secretary, T. H. Wells, Esq., having read the notice convening the meeting, the minutes of the last ordinary and extraordinary meeting were read, approved, and signed.

The report was taken as read.

The Chairman said: Gentlemen, it will be in your recollection that at our last half-yearly meeting, we were engaged in a competition with a telegraph company, formed in America and known by the name of Mr. Jay-Gould's Company. You are also aware that at an extraordinary meeting, the minutes of which have just been read, held subsequently to that half-yearly meeting, we passed resolutions confirming an agreement with that company, which brings us into a state of harmony with them. Well, gentlemen, I merely allude to that fact, because it prevents us from doing what I generally do at this half-yearly meeting, institute a comparison between the receipts which have accrued to us during the past half-year, with the receipts of the previous half-year. It is obvious that no satisfactory comparison of that kind can be made at present, because the circumstances under which we were operating during the half-year to which I allude were of a nature which renders it impossible to institute any comparison between the receipts. The rate of tariff was entirely different, therefore any comparison between the aggregate receipts of two half-years would be entirely futile and misleading. However, on the 22nd May last, the agreement to which I have alluded having been concluded and ratified on all sides, we recurred to a tariff of two shillings a word, and our experience since our recurrence to the tariff is so far satisfactory. Now, gentlemen, the next topic to which I would draw your attention is as to the expenditure of the half-year. The real expenditure which we can control, of course, is only that of the offices in London and at the stations, and the money laid by to renewal fund. The payment of different expenses connected with the working, independent of the office expenses, are permanent charges, and cannot be very much diminished or increased, but the expenses at the offices admit either of reduction or of increase. It will be satisfactory to you to find that at the head office in London during the last year we have been able to make economies to the extent of £300 a year (laughter). I do not understand the meaning of the laughter. Perhaps you would have rather seen an increase of £300. The different items of expenditure at the central office show an increase of £150 12s. 3d. against a decrease of £474 8s. 3d., showing on the balance a reduced expenditure at the head office of about £325 a year. The expenditure at stations shows a very different result. There the increased expenditure has been about £4,400 a year. Out of this we must deduct a very large expenditure for the provision of new instruments which, of course, became necessary from time to time. We have been obliged to pay £1,000 for new instruments, and we have also been obliged to pay for the use of a patent for the Wheatstone instruments. With reference to this increase of the expenditure at stations, the last time I had the pleasure of addressing you here, I mentionod that, of course, the reduced tariff involves additional work. The only object of reducing the tariff was to increase the number of messages sent, and an increase in messages sent necessarily involves an increase of persons engaged to send them. You cannot do double the work with the same number of people, and that accounts for the increase of expenditure at the stations to which I have alluded. You will find an increase in every item of expenditure which involves the employment of increased number of persons to do your work. There is an increase under salaries and wages of £1,200; an increase in the maintenance of old lines, in stationery, and in lodgings, fuel, and provisions. That accounts for a large portion of the increase in expenditure during the past half-year. We may look for economies in this respect in the future, because as we have raised our tariff we shall not have—of course we are very glad to have it—additional traffic which would cost us more to carry. I am afraid the increased tariff must necessarily reduce the number of words sent and will enable us to make economies in the expenditure. So much for the receipts and the expenditure. I now wish to say one or two words on the subject of the condition of your plant. The lines are all working well. Within the last few months, as you are aware, the Brest-St. Pierre cable, which has been in the water for thirteen years, developed a fault which suspended its operation. During the last winter we have sent an expedition out to repair that cable, and I am happy to be able to tell you that we have been enabled to raise it in very nearly 2,000 fathoms of water. We are not all nautical people in the room, but I may say that 2,000 fathoms means something over 2¼ miles, and we have been enabled to get up that cable which has been thirteen years in the Atlantic, at a depth of 2¼ miles, and repair it. The repairs are not absolutely complete, that is, I cannot tell you that they are, because we have not received a telegram from the ship, though we expect one literally every moment, to say that it is thoroughly repaired and in good condition. In connection with these repairs we have performed a feat which I think is of some importance. We have laid down in the centre of the Atlantic, in connection with this cable about ninety miles of new telegraph cable. That cable is capable of being raised and added to at any moment. It is a matter of as much certainty as picking it up off the floor of this room, if it lay there, and if it were necessary to make further additions to that new cable; so that I apprehend the life of the 1869 cable will, by the operation we have performed lately, be very considerably prolonged (hear, hear). We have also in that same cable a considerable proportion of new cable within 300 miles of Brest, which we have put in. So that you see we are, so to speak, darning that cable as if it were an old stocking, and making it as good, and probably stronger, than it was before. Well, gentlemen, that is our condition. We have had a good deal of competition from time to time to contend against, and I understand that we are threatened with further competition. Well, perhaps if I were to offer advice to persons inclined to invest their money in new telegraph operations I might be considered as rather an interested counsellor, but I think you may have observed in the newspapers lately letters from my friend on my right here (Mr. Weaver), which appear to me to demolish any chance that this new cable might have had of earning a livelihood. I may tell you that we have gone carefully into the figures and facts connected with the laying of another cable, and I may say that if it comes to a question of hostile competition, we can live and pay our working expenses at a rate of tariff at which it is not possible that that cable could pay its own working expenses. Of course, when I say we can live, it would be a very miserable existence, because we should merely pay our working expenses, and give you no dividend, which I need not tell you is a state of things which I should not like to cultivate, but, on the other hand, our competitors would not be able to live at all—not be able to drag out even such a miserable existence as we should be doing. If men, under these circumstances, are so unwise as to put their money into these undertakings, all I can say is they deserve the fate which I believe they will receive. We are told that these additional telegraphs are required in the interests of the public. The public want to have telegraphing cheaper than they have got it already. Now, it is not necessary to go back to the history of our company in order to show you the enormous reductions made by the board before the question of competition arose at all, in their own interests and with a view of stimulating and increasing the traffic, and thereby bringing in a larger income to the shareholders; but, gentlemen, there is another consideration which I have mentioned before in this room, and that is when such a competition as that which I have attempted to describe arises in which we can make a subsistence, and in which our competitor cannot live, depend upon it the next step in the interest of the public will be a combination for which the public will have to pay. There is nothing in existence more true than that you cannot compel capital to work gratuitously any more than you can force manual labour to work gratuitously, and attempt to force down remuneration of capital below what it will bear, the result to the public will be that they will have a large price for their accommodation, and they will have to remunerate the capital which it is attempted to crush in this fashion. That is my deliberate opinion. I believe that where combination is possible competition is out of the question. The public are interested in increased facilities and cheaper telegraphing, but they will have to pay a larger amount for the accommodation they will derive from these numerous cables than if they were satisfied with a fair rate of tariff from the cables which already exist, and which are more than sufficient to do the business which the public supplies them. Gentlemen, I do not think that it is necessary for me to trouble you with any more observations. This, as you are aware, is the off half-year. We have no dividend to declare, nothing of that description to bring before you, and we merely meet you for the purpose of keeping you fully informed as to the state of your undertaking and as to the condition of the company, and I shall, therefore, merely conclude by moving that the report of the directors and accompanying statement of accounts to June 30th, 1882, submitted to this meeting be, and the same hereby are, received and adopted.

Sir James Anderson seconded the motion.

Mr. Trotter said that he was quite certain that the board had exercised its best judgment in the administration of the affairs of the company, but he did think it was open to discussion whether their policy, as it had been explained to them, was the wisest possible. Their policy had been combination, to endeavour to create a monopoly. That policy was one which was not favourable to their interests, and he ventured to think that if there was truth in the remark of the noble chairman that the public would have eventually to pay for competition, it would come to this, that in any enterprise whatever the public would have to pay for all capital invested, whether well or ill. He did not believe in that. Upon the last occasion on which he had been present at a meeting of the company, about five years ago, he had just returned from America, after travelling some 25,000 miles in the country, and he then ventured to state his belief that the true policy of their company was not in combination, but in treating the public in a liberal manner, in being content in the first instance to make smaller profits, and meet competition as it arose. The tariff of one shilling for twenty words was anticipated as fatal to the prosperity of the telegraph companies; but they all knew how Mr. Rowland Hill was scouted when he prophesied success for the penny postage, instead of rates of 1s. 6d. and 2s. 6d. Now, he did believe that every combination, every endeavour to create a monopoly, had resulted in a considerable fall in the value of their property (hear, hear). He was seriously concerned to see their property at 50 per cent. discount, which meant a depreciation of its market value to one-half of the whole value. He thought the policy had not been successful, and he ventured to believe that if they had been content with the low rate per word, and had left the traffic to increase, as he believed it would have done, by itself, they would not have stood there that day to receive such a small dividend as they now did, or to see their property depreciated one-half in market value.

Mr. Aston said that the question was, was the meeting in favour of combination or not? If it was, then let it go on; but if the feeling was against it let them consider whether it would be wise to pass the resolution submitted before they strengthened the constitution of the board. He must confess that there appeared to him a great

lack of backbone on the board. With regard to the effect of combination there had been a great falling off in their value. In August, 1873, after the first combination, their stock was at 90; in May, 1877, it was at 60; in February, 1881, it was at 59; in July, 1882, at 52; and it was now something under 50. These figures were not satisfactory to him. It struck him, too, much might be said besides upon the question of combination. They had now a considerable reserve fund. He did not see why they needed to add to that; they could make a cable with what they had, and if not they should borrow. He did not like to see their stock standing at 50, and he thought they wanted a stronger board, with more strength and more backbone in it. He believed that there was now a vacancy upon it. He objected to that very much. If there was a number fixed they ought to keep to it. He would move that a committee be appointed, and that this meeting be adjourned for the purpose of receiving a report from them. He had nothing to say against the board individually, but he did think their policy ought to be opposed.

Mr. Henry Rutson said he only rose to support what had fallen from the last two gentlemen. This policy of combination had gone on for a long time, and it appeared to him not very successful. He thought they would strangle all these new cables if this meeting declared itself against all further combination.

Mr. Newton said that this company would soon have to take steps to fight these new companies. He had always advocated the policy of fighting. He objected to combination, because it was disastrous to the interests of the company. He would like to refer to one or two points in regard to the position of the company. The chairman had told them that they took up their cable from the middle of the Atlantic from a depth of 2½ miles and put in a new cable, and that they could pick it up as if it were in this room. That fact was one of the most tremendous facts that had ever been announced at their meetings (laughter). It established their property in such a manner that they need have little regard even for their reserve fund. They had been always accustomed to hear that the life of a cable was ten years. It was very clear that they had now got a substantial property, that they were really now remaining in it as investors, although they were very little else than speculators at the present moment, considering what a very fluctuating property theirs had been, and how serious was their position as regards competition and dividends. With reference to competition, it struck him that in America it was prosperity which brought new schemes into existence. He had read in one of the evening papers this week that there was a new combination established in America simply because there were such wonderful dividends coming out of them. In this country it seemed to him that adversity brought new schemes into existence. The adversity of shareholders in these companies was always the forerunner of a new competing scheme. There might be some connection between the two as regarded operations on the Stock Exchange. He had heard it explained as being a great mystery, and that the only explanation was that investors were crops of fools that were continually being gathered in by promoters. He thought the Atlantic afforded to cable makers a great field for plunder. Cable contracts amounted to a sum of money something like 1½ millions, and in that there was a vast deal of plunder. The makers of cables found some people, who were not fools, to provide the means of getting a contract. Out of every £100 subscribed there was a percentage for insurance. Then the cable was underwritten, and in all probability, notwithstanding that this European cable scheme had been knocked on the head as far as investors were concerned, it might come into existence from the fact that the cable was already underwritten, and the gentlemen interested protected by a system of insurance. The way to fight that sort of thing was that of combination, which they had always adopted. He was not going to say anything personal, or make remarks against particular directors, but he did wish to make a few remarks against boards in general. It was not the adversity of shareholders that brought those new companies into existence, it was the tremendous prosperity of the directors (hear, hear). If they allowed that sort of thing to go on, they would become speculators, and he could prove it. It was one of the abominations of the City of London that shareholders are plundered by directors of the highest character and reputation (laughter). He held in his hand a list of fees paid to directors in cable companies—companies which were controlled by gentlemen whose names appeared on various boards. He trusted he was saying nothing offensive—he was simply speaking in the interests of the vast majority of investors in this company—those who put their money into it for interest only. The duty of directors was something beyond that of merely receiving fees (hear, hear). In that list which he held, it was shown that the directors of telegraphs were receiving £34,525 a year, and yet when they were attacked all round, the directors did not fight for them (name, name !). He had not made it up with names; he was not going to mention names. It was a question simply of policy and principle—it had nothing to do with names. If he were to begin naming names, there would be simply animosities all round. He had seen animosities enough raised by the way in which he had attacked principles, and he did not wish to increase these by attacking names. He held a list of the fees in the Anglo-Brazilian, the Direct, the Eastern, the Eastern Extension, the Globe, the West Indian, the River Plate, and the Telegraph Construction. But the directors of the Telegraph Construction earned their money beyond all others—he would not cast a single reflection on the Telegraph Construction. If ever a board of directors earned their fees, it was that one. He simply included it because it belonged to that charmed circle which they so often saw referred to in the newspapers. Well, in that number the fees paid amounted to £21,750. On these prospectuses they would find magnificent institutions—institutions which there was no equal to. The London and Westminster Bank actually figured there in a prospectus which was the concoction of a gang of speculators. Great dock companies were also represented on the board, who came forward with a subterfuge calling themselves trustees. These gentlemen were not fought as they ought to be. They should have fought the last French cable to the death not only of the shareholders but of the directors as well (hear, hear). But what did they do when they came to the point of destruction of the property? They left the men who were responsible for it untouched; the trustees, who were always trustees before they became directors, in the comfortable possession of some thousands a year. Some of these gentlemen earned more as directors than they would ever have done had they been twenty years in the business they "directed." That was the point to which this company should direct itself, and to which a committee should direct itself, that the question should be fought not merely as against the proposed new schemes, but against those who were behind the schemes, and names never mentioned except at meetings of the shareholders. The French scheme was fought so far, but they did not fight the directors on that occasion. They allowed one whose name should never have been allowed to remain on any board to remain at that board (oh, and name). It was not for him to mention names. Those who knew these things as he did should look for themselves. That statement of his could not be disputed, and they must sooner or later fight them to the complete death, and not to the half death, in the interests of their shareholders. Punish the shareholders, but punish the directors too, and let the latter have the most of it. Don't let directors sink into splendid positions—sinecures—where they barricaded themselves with proxies, and got an annuity for the rest of their days whether they worked or not. With reference to the European, American, Canadian and Asiatic Cable Company he found that it was now on its very last legs. He might tell them that, for he had seen a circular sent out in the usual way, which was an announcement that if any of their stock was disposed of there would be a large commission given for doing so. That only bore out what he had said of the margin which lay between the capital of the real money received spent in these commissions, and in sums for insuring.

Mr. Griffiths thought that the application of the word *combination* to the company was not a fortunate one. The company had started with a moderate capital, and the stock had been watered. Mr. Newton had made some very able remarks, and certainly it was not wise that they should continually combine with other companies if the combination was merely for their advantage; but he hardly agreed with all that he had said as to the question of policy. He thought they might gain much more by the development of telegraphy and by allowing affairs to take their own course. Nine-tenths of the commerce of the world was carried on through the agency of the telegraph, and as commerce increased so must telegraphy; but whether they combined for peace or war he could not say that he thought the policy pursued during the past twelve months had been altogether satisfactory. They had lowered their rate to one shilling, and for nearly ten months they had carried messages at a price which was hardly remunerative. What wonder was it if the dividends fell off? They were fortunate in having on their board gentlemen of great ability; but on the other hand, they should remember the remarks of Mr. Newton, that there were gentlemen of great ability who were not on the board (laughter). He should certainly be in favour of combination or of getting a few of such directors on their board. An increase in the number of their counsellors would take away from the enemy the chance of so well managing their schemes. He thought by that means that they would be more likely to retain their dividends than by lowering their rate and anticipating warfare. The present position of their company was somewhat critical. He was sorry to hear Viscount Monck remark that they could not compel capital to work gratuitously, at least, if so, that the public would ultimately have to pay for it. That was somewhat ambiguous. It was true the public might have to pay by subscribing additional capital; but he was afraid they would also have to pay for it by losing their dividend. He thought, therefore, it would be wise to follow the plan already suggested, that they should rather look to the increased development of trade, and seek to gain their fair proportion of the trade than go to war and lower their dividend to so great an extent. They would also by that means avoid the necessity of having such large renewal funds.

The Chairman: I am very unwilling at a meeting of this kind to appear to intervene before full discussion has taken place, and I have therefore abstained from stating my views at an earlier period of the resolution which has just been placed in my hand by the gentleman at the other end of the room. Now, gentlemen, you are all aware that this meeting is not one which has been called for the purpose of discussing the action of the directors or the constitution of the board, or anything of that sort. No notice has been given of this amendment, which has been sprung as a surprise upon us in the room without our knowing that there was any intention of anything of the kind. It is not an amendment of the resolution which I had the honour to propose at the opening of the meeting, because that resolution merely referred to the report and accounts which have been laid before you, and according to the established rules of order which guide all meetings, it is therefore entirely out of order, and I should be acting exceedingly improperly if I allowed it to be put to the meeting. But, gentlemen, there is another reason which I wish to lay before the meeting quite independent of the question of order. It is this: There are in this company upwards of 5,000 shareholders. No action of the board attacking the interests of the company has ever been taken—I mean any considerable action—without these shareholders having been called together, consulted, and allowed the opportunity of expressing their opinion upon it (hear, hear). On no occasion of this description has there ever been any opposition to the action of the board. I might almost say that literally; but, at least, if there has been any partial opposition it has been of such a character as ought to bring out into stronger light the unanimous support which the board receives from the great bulk of the shareholders. I have no personal feeling in the matter, and Mr. Newton may be perfectly certain that I entertain no opposition to his discussing my position in any way that he likes, but I do not think it is fair to the board, or fair to th

shareholders of the company, to allow a meeting such as I see before me, however respectable the individual gentlemen may be, a meeting which numerically bears no proportion whatever to the shareholders of the company, I do not think it would be right for me in such a meeting, even if the amendment were quite in order, to allow it to be put. If any dissatisfaction of the action of the board is felt, let notice be given fairly at a half-yearly meeting. If it is considered to be of such an urgent character as to require to be discussed before the next half-yearly meeting, the articles of association provide means by which, within a very few days, we can get the shareholders together, and get their opinion honestly and fairly upon any proposition which might be made to them; but, gentlemen, I cannot stand here, if even this amendment were in order, and allow it to be put to a meeting numerically composed as this is, in the absence of the majority of the shareholders. It is no disparagement to the gentlemen present to say that they are a mere drop in the ocean compared to the number of shareholders in the aggregate. On both these grounds I, as chairman, decline to put the amendment to the meeting. The articles of association provide that an extraordinary meeting may be called if the requisition, by any number of shareholders not fewer than five, and holding in the aggregate not less than 5,000 shares, with a full statement of the object of the meeting, be delivered to the secretary or left at the office. That is the course provided by your articles of association for considering such a proposition as this. I challenge those who have brought forward this proposition to take the constitutional course provided by these articles, and I shall be ready to meet them foot to foot and hand to hand whenever they take that course and propound their resolution before a meeting of shareholders properly called for the purpose of considering that resolution.

Mr. Aston submitted that the resolution was entirely in order. He felt very much flattered by the objections taken by the chairman, because they seemed to imply that if the amendment were put the meeting would endorse and pass it (no, no). One part of the amendment was certainly in order, for the meeting had surely the power to adjourn. He would suggest an adjournment to the 3rd November, whether they appointed a committee or not. He did not see the use of calling shareholders together on every point that arose, and spending £18 or £20 in doing so. It was no new point that had been sprung on the board. All the world was full of the combination question. Had they not found themselves face to face with combination after combination and company after company? He did not wish to press this against the feeling of the meeting, but he was certainly in order in moving an adjournment. He did not come with a formal resolution prepared, but simply to express his feelings, formed with some deliberation, that there was not enough backbone in their board, and that they wanted new blood.

Mr. Newton thought it a misfortune and a mistake that the amendment was not allowed to be put. Those who came there did so at considerable trouble; those who stopped away did so for their pleasure, and he objected to a meeting of shareholders being prevented from an expression of opinion. The board unquestionably had the confidence of that meeting. He objected to resolutions being brought forward without intimation; but he did not object to a gentleman who felt aggrieved bringing the policy of the board before the meeting. If it was put it would only show who supported him, and so assist the board in forming an opinion in regard to the popularity or otherwise of their course of action.

Mr. Humphreys said that one objection taken by the chairman was founded on a perfect fallacy. All the shareholders had the same privilege of coming to a meeting of this kind as they who had come, and, therefore, if anything were done in the absence of those, they ought to suffer and not they who were present. To say that they should not entertain the question because the meeting was numerically small was a fallacy he must protest against as contrary to English law. In a parish vestry, for instance, the old parish could be taxed if only three parishioners were present; and in all meetings of this kind, those who were present could act as they pleased without considering those who were absent. In regard to combination, it was true that no sooner had they come to peace with a competing company than some other company rose up and they were again in hot water. But the question was, how could they stop it? He thought fighting was the best way to stop these new companies rising continually and claiming a share in their profits; and no doubt companies were formed simply in expectation of their coming to terms with them, and for nothing else. He did not think, however, that the laying of these new cables was injurious to this company, it was rather beneficial (laughter). Decidedly he did. If they could buy new cable at half the money they were made for where was the disadvantage? As to this new cable company it was not likely that anybody would give £100 for shares, while their own shares were at £50. The English people were not such silly folk as to give £100 when they could buy the same identical thing for £50. Therefore that new company was not altogether opposed to them, because cables naturally wore out, and it was something to get a new cable at half its cost.

The Chairman said that he thought his position had been rather misapprehended. The last speaker had told them that a meeting of shareholders had a right to do what they liked; but if they meant to conduct business in a business-like way, they must conform to the rules which regulated all meetings whatever, and to the constitution of the company to which they belonged. He, as their chairman, deliberately announced his decision that that amendment was out of order. If they were dissatisfied with that, he presumed that the theory of English law would apply, that there was no grievance without a remedy; but standing there as their chairman, it was his right to say what was out of order, and he deliberately pronounced that amendment to be so. The reference to the numerical character of the meeting was merely to show that he had not been actuated solely by a technical question of order, but that there was a substantial reason why they should not allow a small number of gentlemen to pronounce on the interests of the 5,000 shareholders of that company. He would now put the resolution to the meeting.

The vote having been taken, the Chairman said: I pronounce the resolution carried, with four dissentients.

Mr. Aston: The amendment clearly might be put.

The Chairman: The resolution is carried; I decline to put the amendment.

Mr. Burt, solicitor to the company, said that he had had considerable experience of such meetings, and he thought Mr. Aston must be well aware that it was irregular to put such an amendment to the meeting, and he begged to say that the chairman was perfectly warranted in the decision come to, not only by the ordinary rules of conducting public meetings, but by the particular regulations of the company. He should be exceedingly sorry if such a thing had been done without any notice whatever, which would have been a great injustice to all the shareholders.

Mr. Aston said they were perfectly within their right in adjourning the meeting. (Mr. Aston then left the room, making use of a strong expression against Mr. Burt.)

On the motion of Mr. Newton, seconded by Mr. Smith, a vote of thanks to the chairman was then unanimously adopted. The chairman briefly responded, and the proceedings terminated.

SOUTH EASTERN (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

An extraordinary meeting, followed by a statutory meeting, of the above company was held on Wednesday last in the City Terminus Hotel, Cannon Street, General Sir Michael Kennedy, R.E., chairman of the company, presiding. The Secretary having read the notice convening the meeting,

The Chairman said: Gentlemen, this is a special meeting convened for the purpose of making certain alterations in our articles of association. These alterations have been dictated to us by the Council of the Stock Exchange, and it is necessary that they should be made before the Stock Exchange will grant us a quotation. They have already granted us a settlement, but we are not in a condition to apply for a quotation, inasmuch as we have not sufficient capital paid up, that is, under a recent rule of the Stock Exchange a quotation is not granted except in cases where capital is paid up to the amount of £50,000. The alterations we have met to consider are not very numerous or very important in their scope, and in no way affect the interests of the shareholders, and no doubt you will approve of them without any difficulty. The first is in article 4, and the object of it is to prevent the directors, without the assent of a general meeting, issuing any shares at a discount; that is, to prevent the directors from watering the capital. The next alterations are in articles 81 and 89, and they have for their object the reduction of the term of office of the first directors from the year 1886 to 1884. The next is the omission altogether of article 85; and this the Stock Exchange require to be expunged apparently for the reason that it would enable important considerations to be decided by correspondence, instead of being thrashed out in a general meeting. The alteration in article 100 is similar in its scope, but it has application to the directors; that is, to prevent in the same way the matters which properly ought to come before a meeting of the directors being settled by correspondence. That is all, gentlemen. With these remarks I beg to move "That the articles of association be, and the same hereby are, altered as followed:—

"(I.) By the insertion of the following words at the end of article 4, 'Provided always that no share shall be issued at a discount without the sanction of a general meeting.'

"(II.) By the alterations in articles 81 and 89 of '1886,' therein mentioned, to '1884.'

"(III.) By the omission of articles 85 and 100."

Mr. F. Fesser seconded the motion, which was then put to the meeting and carried unanimously.

The Secretary then read the notice convening the statutory meeting, and

The Chairman said: Gentlemen, this is our first statutory meeting. As usual on such occasions we have not very much to communicate to you. Electric undertakings, like all other enterprises of a similar character, require after their commencement to work on gradually to development. Up to the present time our work has been chiefly with preparation and organisation for the business which is no doubt before us as time goes on, and with the decline of the year, when the demand for electricity will no doubt become greater than we can expect it to be during the long days and short nights of the summer. The company was incorporated on May 2nd with a capital of £100,000 in 20,000 shares. 104,730, or more than five times the number offered, were applied for, and, including 400 paid-up vendors' shares, all these were allotted. As soon as we were in a position to do so we applied for a settlement, and the date of our application was June 3rd. A settlement was obtained on the 29th of that month, but under a recent rule we could not obtain an official quotation till capital has been paid up to the extent of £50,000. We did not consider it advisable to make a call of £1 per share due on June 1st, because we had no immediate prospect of utilising the money advantageously and we thought it would be more in the interests of the shareholders that we should not call up additional capital until we were in a position to employ it advantageously. We engaged offices at 110, Cannon Street, and we made arrangements by which we shared those offices with the Provincial Brush Company, and of which you are aware your directors are also the directors. Mr. Offor, our first secretary, we appointed our manager, as we thought his great experience in electric business in general, and of the Brush in particular, would be more advantageous than if we continued to employ him in the purely ministerial office of secretary. You are also fortunate

enough to have the services of Mr. Beeman, as electric engineer. This gentleman was Electrical Inspecting Engineer of the Anglo-American Brush Corporation, and had had charge of the City lighting. He is an officer of experience and of talent, and has patented several useful inventions in reference to electric lighting and appliances. Under our engagement with him we are entitled to share in all his future discoveries, and I may say we see the dawn of great advantages in that respect to us. I cannot, at present, enter into details. It would not be right or proper to do so; but I may say I see the dawn of the near approach of results which I think will be very advantageous to this company. Mr. Offor, Mr. Beeman, and our secretary, Mr. Jermyn, also act in similar capacities for the Provincial Brush Company, an arrangement which is beneficial and economical to both companies. As soon as our organisation had been completed we took plans to lay the foundation for the important business which is, I have no doubt, eventually before us. We advertised in the local papers in our three counties, and we circulated widely a pamphlet drawn up by our manager, which gives full information regarding our system—the Brush system, and with details of prices and cost of installations and other useful information. Our manager, our travellers, and some of our directors also visited some of our chief towns, and I may say they were everywhere well and favourably received, and I am bound to add in every case the answer was that however well disposed to us, they could not take any steps until the bill now before Parliament had become law. In addition to other business, we have carried out successfully a very large installation at Parkeston Bay, near Harwich, for the Great Eastern Railway Company. This I believe to be only the forerunner of a very much more extensive business in that direction. Generally, I may say, we have had numerous applications from firms and individuals in reference to installations in the use of our system, but we have been met by two difficulties; one is that which I have already alluded to, the want of legal powers, for getting down our mains, and means of supplying electricity; and the other with reference to a secondary battery or accumulator; which we find to be most important, and, indeed, an essential component part of every large system of incandescent electric lighting. Both these difficulties, I may say, are now in process of being removed, and will, I believe, shortly disappear. We have taken part in a very important movement, and have joined with the other Brush companies in forming a Brush council or conference, which will take into its consideration subjects of common interest, and will concert common action and protect common interests. Delegates from each of the companies concerned have already met, and have considered and arranged their future mode of procedure, and have already passed some important resolutions in reference to the quality and price of the machinery and plant which under our licences we obtained from the Anglo-American Brush Corporation. I think you will see that as all the Brush companies work under the same licence, but on totally distinct and separate ground and localities, that their united action must be very powerful and cannot but be very beneficial to the common Brush interest. I will now say a few words as regards the Electric Light Bill. All those concerned in electric lighting must have followed the course of this bill with a great deal of interest, probably not unmixed with a little apprehension. I was prepared to address you on this subject in a somewhat different strain, but I am happy to say that the bill in committee was yesterday amended in a very important particular, and the period for which licences may now be granted with the assent of the local authorities, was altered from five, as originally drafted, to seven years, and the period for which provisional orders can be procured, with the assent of the local bodies, has been altered from fifteen years to twenty-one years. This concession, taken in connection with the compulsory sale clause, is very important; but I think, gentlemen, that as far as lies in us, we should not stop here, but should endeavour by agitation and such means as may be within our power, to obtain a revision also of the compulsory purchase clause. That clause seems to me to be extremely inequitable, for it provides that electric undertakings should be compelled to sell their works at the close of the period named for the mere value of the plant and the material, without any allowance whatever for the goodwill of the concern. I do not think, gentlemen, that this clause can stand, but at present we must do the best we can as it has been amended. It is very encouraging to find that there is a general and growing opinion that there is a great and immediate future for electric lighting, and wherever this subject is discussed, whether it be in Parliament or out of Parliament, or in the columns of the public press, that view appears to be strongly held, and I for one am entirely in accord with the remarks made in a leading article in the *Times*, on the 7th July last, to the following effect: "that there was a vast field for electric work, and so far from having to educate the public to the use of electricity, as some would seem to think it required, those concerned in its distribution will be speedily applied to by more customers than they can deal with." Our own experience, I may say, already tends that way. As regards our action in connection with the Electric Light Bill, I may state that for some time past we have had under careful consideration how we should act. I cannot enter into details now. It would not be advisable to do so, but I can assure you our arrangements are such that we can take necessary action as soon as the bill is passed.

Mr. Robinson asked whether any operations were at present being carried on by the company, or whether any contracts were made.

Mr. Stewart asked whether they had carried through any negotiations for the sale of sub-concessions in their district.

The Chairman said that, besides the work at Harwich, they had negotiations a-foot in a great many places which would, he believed, be successful when the difficulties were removed which at present were interfered with by the state of the law, as to the opening up of streets, and getting in their mains and wires. As to the sale of concessions, the same difficulty was before them, and as soon as they had legal powers he had no doubt they should obtain applications for concessions in various quarters, but that was not likely as long as the matter remained uncertain.

A Shareholder asked whether it was intended to make a call.

The Chairman said that he had already explained that they did not call up any money because they did not require it at the moment, and they thought it was preferable to leave it in the shareholders' hands than keep it unemployed at their bank.

Mr. Stewart asked in what securities they had placed the money in hand, so as to be yielding the company a fair return.

The Chairman replied that the greater part of it was in their bank on deposit, yielding a small amount of interest.

A Shareholder asked whether the prospects of the company were as good now as they were at first. He thought that gentlemen there were very well aware that a great stimulus had been given to the gas companies by the bringing out of electricity, and it would be interesting to know whether gas was going to carry the day, or whether the electric light was likely to get into favour. There had been a very interesting statement made in Parliament lately, namely that upwards of 90 applications had been made for the introduction of electricity, and he thought they would like to know if this company was one of those that had made that application to the Board of Trade.

The Chairman said their prospects were certainly as bright now as they were when they first commenced; he thought considerably brighter, because they were now approaching a time when they could really take, as he hoped, effective action. Up to the present they had not been able to take any action for want of legislative powers, and, until they had these powers, they could not commence to compete with the gas companies, as he hoped they should be able to compete successfully.

In reply to another question, in regard to the obtaining of some accumulator,

The Chairman said that they had hopes and prospects of settling that very question soon. He could not say more at present, but he hoped they would be content for the time being with what he had said. He would add that this company was not one of the number which the Lord Chancellor had stated would make application. He had no knowledge whatever of who had made them.

Mr. F. Fesser (vice-chairman) said he should like to say a few words in reply to some inquiries made by gentlemen opposite him as to whether their prospects were now as bright as they were. When they issued their prospectus there was a mania raging, and a very great deal more was expected of the electric light and of the capital invested in it than ought to have been. At the present moment it seemed that they had rushed into the opposite extreme and fallen into a condition of despondence, and many of those who had thought the electric was the light of the future had begun to think that there was no hope of competing successfully with gas. Some remarks made had echoed that same feeling which seemed to be undermining the public sentiment. In his own opinion their prospects were very considerably brighter now, because the science of electric lighting, although new, was making such gigantic strides, and they were hearing every day of such enormous advances that they had not the slightest doubt it would supersede every other method of lighting. A great deal had been said of the result of the tenders for public lighting in the City, and he was sorry to say that most remarks that he had seen in the public papers seemed to show that the result of these tenders was incontestably that the electric light had proved five or six times as dear as gas, and it was quite impossible to compete, and that there was an end of the whole matter. Now, if they took any gas company in England, except that which happened to have mains laid down in those particular streets for which the City Commissioners had invited them to supply one year's lighting, and were to ask that company to tender for lighting it for one year, they would find that the gas would not be four or five, but twenty, and perhaps even fifty times more than the privileged gas company was at present charging. The terms of the electric light contract were that they were to supply the lighting for one year, that was, erect their plant and machinery, and remove it at the end of the year; on these terms it was impossible to compete with gas; but wherever electric lighting was allowed fair play, it was not only infinitely a more brilliant and wholesome and pure light, but very much cheaper. If any railway company were to erect any gaswork to do what they were doing at Parkeston Bay with the electric light, it would be quite too terrible, and they must act under the same conditions as those which the gas company acted—on the same footing; then they should then be able to compete with gas, but not before. He hoped that before many days they would have the law in their favour, and be able to lay down their wires on a fair footing. Then they must remember that the gas companies did an immensity of private lighting, and that enabled them to supply the public lamps more cheaply. The electric companies must have the same privileges. As soon as that bill became law he felt sure that they would be able to beat gas.

Mr. Hesse asked if they had a quotation.

The Chairman replied that they had not, as they had not yet £50,000 paid up capital.

Another Shareholder asked whether any formidable competition was likely to arise in their districts with other companies.

The Chairman remarked that they did not anticipate competition, but their Manager, Mr. Offor, would perhaps give them his experience on that point.

Mr. Offor said that the obvious answer to that question was that the survival of the fittest would be the rule that governed their success. They believed that the Brush system was the only practicable one at the present time, and therefore they felt confident that no competition could ultimately oppose them to any serious extent. The public mind was to a certain extent confused by the recent Crystal Palace Exhibition. A large number of lights were burning there connected with different systems, but without the slightest evidence of the cost of producing these lights. He might mention that the Brush system had been carried on in the City at a very small cost indeed compared with the lighting of similarly extended districts by Messrs. Siemens Brothers, whose light had now disappeared from

the City, owing to its great cost. The Brush light, in a circuit of 3½ miles, had been wrought from one dynamo machine running in their works at Lambeth; whereas the Siemens light required for a somewhat smaller circuit, he believed, 12 or 14 dynamo machines. He might mention also, that in the case of the installation at the Great Eastern Railway Company's station at Parkeston Bay, their contract was based upon their supplying the light within one week from the date of it. They had undertaken that, and done it within the week. That showed that the skill now at the disposal of the company was sufficiently efficient to enable them to carry out any work of that kind. He had visited many of the towns in their district, and had had a great deal of correspondence with officials connected with councils and local boards, and he found in all these towns that there was a gas interest opposing the electric light interest. In one town the people had determined that next November representatives should be returned who would support the introduction of the electric light, as opportunity offered. In addition to the installations there had been also many smaller installations for the purpose of making their light known without expense to the company, and they had done that by means of a portable apparatus which they could readily send from one part of the country to another, and with the aid of this apparatus in a few hours they could give the light of 12,000 candle-power. During the present week they had carried out installations of that kind at Richmond. On Monday they lighted an enormous fête attended by fifteen or twenty thousand persons. There in a few hours they had their lights installed and running, and it created a great deal of public interest, and would be followed, no doubt, by some arrangement being very speedily carried out by the local authorities of Richmond, who had now had an opportunity of seeing the light. Last night they lighted up a Blue Ribbon Army meeting, and considerable interest was manifested in the light. All this they had been doing in different parts of their district, and with the believed, very satisfactory results.

Mr. Robinson inquired whether the company had the power to light private houses?

Mr. Offor replied in the affirmative. The company possessed not only the arc lamp, which was suitable for the larger spaces, but also the incandescent light, which was suitable for smaller sized rooms. This company had a contract from one gentleman at Eltham, who was going to pay the company three times the price he had hitherto paid for gas, for the privilege of having the incandescent light in his house.

Mr. R. Cunningham (a director) said he might add that he had been to nearly the whole of the towns in their district. He had seen no competition, and their company had been first in the field.

No further questions being asked,

The Chairman said they had given the shareholders all the information in their power, which he hoped had been satisfactory to them as far as it had gone.

On the motion of Mr. Briers, seconded by Mr. Comberbatch, a vote of thanks to the chairman was unanimously adopted, and the proceedings terminated.

PROVINCIAL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

On Wednesday, at the City Terminus Hotel, Cannon Street, under the presidency of Sir Michael Kennedy, an extraordinary general meeting of the members of this company was held for the purpose of considering and, if thought advisable, of passing as a special resolution certain alterations in the Articles of Association, which were to precisely the same effect as those set forth in our report of the South Eastern (Brush) Company, reported in another column.

The notice convening the meeting having been duly read by the Secretary, Mr. Alfred Jermyn, a resolution for alteration was moved by the Chairman, seconded by Mr. F. Fesser, and carried unanimously.

The first statutory general meeting was then held, in opening which the chairman repeated in substance the remarks he addressed to the sister company, the South Eastern Brush Company, and reviewed the prospect of more work for this company during the winter. The company, he added, was incorporated on May 8th with a capital of £200,000 in 40,000 shares. 134,376, or more than six times the number offered, were applied for, and the whole available number—20,000 shares—were in the first instance allotted. Owing to certain withdrawals, which the board considered had legal force, the total number now allotted was 19,841. As soon as they were in a position they applied for a settlement, and their application was dated the 13th of June. As, however, it took some time to settle such matters, they had not yet obtained a settlement, but they expected to do so daily. They shared offices with the South Eastern Brush Company, and the same officials acted for both companies. In addition to other business, the company had installed lighting at Bedford, High Wycombe, Sudbury, and Stowmarket, and they had had numerous other applications. Having alluded to the Electric Lighting Bill, to the Brush council or conference, and spoken of the position of the company in reference to them, he remarked that the company had matured their plans, and were prepared to put them into force as soon as the Electric Lighting Bill became law.

In the meantime, he might say, as regarded competition, that they had a good and well-tried system, and also an efficient and energetic manager (Mr. Offor). Frankly, he might say that as regarded ultimate results, he did not think there was much to choose between any of the principal electric systems; but it was not in that direction that they looked for their benefit. It was in the details by which those ultimate results were attained; and these were matters which would stand them in good stead. They believed their Brush system [illegible]n all respects, as regards the mode of producing the light, and of it, the fittest; and they had confidence that in the struggle for existence which was about to take place it would survive. If any gentleman had any question to ask he should be glad to give him an answer.

After a considerable pause, and no question being put, the chairman declared the meeting at an end.

A vote of thanks to the chairman and directors concluded the proceedings.

THE Stock Exchange Committee appointed Friday, the 11th inst., a special settling day in the following securities:—British Insulite Company, Limited, shares; Swan United Electric Light Company, Limited, shares; Australasian Electric Light, Power, and Storage Company, Limited, shares; all the above to be marked; Metropolitan (Brush) Electric Light and Power Company, Limited, shares; Railway Electric and Appliances Company, Limited, shares. The committee have granted a quotation in the following security:—Electric Light and Power Generator Company, Limited, 22,500 vendors' shares.

APPLICATION has been made for a special settling day in the Gulcher Electric Light and Power Company, Limited, shares.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Aug. 9.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	15½-16½	15¾.16¼.¾.16.¼.¼.½.¼
		Do. Do.	10	33 - 38	35½.¾.6
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	¾- 1¼	[illegible]
25,000	5	Great Western Electric Light & Power Co.	2½	¾- 1¼	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	7 - 8	7½.¾.½
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	¾- 1	¾
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1½- 2	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49½- 50½	53
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	80 -81	80½.80.¾.80.¼.½
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	20 - 21	20¼.20.¾.21
130,000	10	Brazilian Submarine, Limited	10	11½- 11¾	
16,000	10	Cuba, Limited	10	9½- 9¾	9¾ xd.
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
13,000	10	Direct Spanish, Limited	9	5½- 6½	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11¾
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10 - 10½	10¼.3/16.10 xd
70,000	10	Do. 6 per cent. Preference	10	12½- 13	12¾
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	100 -103	101½ xd.
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11 - 11½	11 3/16
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	104 -117	xd.
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	..	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6½.[illegible] xd.
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	12¾ xd.
125,000	10	Great Northern	10	12½- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	25 - 26	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	28½- 29½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	2 - 2½	
8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	265 -275	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	98 -103	
37,350	12	Telegraph Construction and Maintenance	12	27½- 28½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	6½- 7½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	8½- 8¾	
4,669	10	Do. 6 do. 2nd do.	10	6½- 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1¾	1¾ xd.
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	¾- 1	
100,000	5	United Telephone Co.	5	10½-11½	11¼.10¾.11.1/16.¼.11

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of July was 2,948, estimated to produce £2,800, against 2,494 messages, producing £2,397, in the corresponding month of last year. The traffic receipts for the months of May, estimated at £3,300, realised £3,544.

The Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of July, 1882, are £1,846, as against £1,448 in the corresponding period of last year.

The Eastern Extension Telegraph Company. The receipts for the month of July were £30,070, against £31,751 in the corresponding month of last year.

The Great Northern Telegraph Company. The traffic receipts in July, 1882, were £21,640 from the 1st January to 31st July, 1882, £137,200, in the correspon[illegible] months of 1881, £137,166, and in the corresponding months of 1880, £131[illegible]

The West Coast of America Telegraph Company, Limited. The receipts [illegible] two weeks ended the 14th July were £1,825, against £1,675 in 1881. [illegible]

The Western and Brazilian Telegraph Company, Limited. The tra[illegible] this company for the week ending July 14th, 1882, were £1,898, ag[illegible]

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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THE RESISTANCE OF CARBON AND THE TELEPHONE.

It is a little curious that all through the telephone controversy during the past four or five years, and also in the recent lawsuits of Edinburgh and London, no mention has been made, as far as we are aware, of the experiments made as long since as 1866 by Mr. S. Alfred Varley with carbon lightning guards. It is well known that this gentleman has claims jointly with Sir Charles Wheatstone and Dr. Siemens to the discovery of the reaction principle upon which the dynamo-electric machines of the present day are constructed. In 1870 Mr. Varley read an important paper before Section A of the British Association meeting at Liverpool on "Lightning and Telegraph Wires," and this was published in our contemporary *Engineering* on the 7th of October in that year.

Mr. Varley, when experimenting with electric currents of varying degrees of tension, had observed the very great resistance which a loose mass of dust composed even of conducting matter will oppose to electric currents of moderate tension.

With a tension of, say, fifty Daniell cells, no appreciable quantity will pass across the dust of blacklead or fine charcoal powder loosely arranged, even when the battery poles are approached very near to one another.

If the tension be increased to, say, two or three hundred cells, the particles arrange themselves by electrical attraction close to one another, making good electrical contact, and forming a channel or bridge through which the electric current freely passes.

When the tension was still further increased to six or seven hundred cells the author found the electricity would pass from one pole to the other through a considerable interval of the ordinary dust which we get in our rooms, and which is chiefly composed of minute particles of silica and alumina mixed with more or less carbonaceous and earthy matters. Incandescent matter offers a very free passage to electrical discharge, as is indicated by the following experiments. The author placed masses of powdered blacklead and powdered wood charcoal into two small crucibles; no current would pass through these masses of powder whilst they were cold, however close the poles were approached, without actually touching. The battery employed in this experiment was only twelve cells.

The crucibles were then heated to a red heat, and electricity freely passed through the heated powder, and on testing the resistance opposed by the heated particles, placing the poles 1 in. apart, and employing only six cells, the average resistance opposed by the blacklead was only four British Association units, and that opposed by the wood charcoal five units.

These observations go to show that an interval of dust separating two metallic conductors opposes practically a decreasing resistance to an increasing electrical tension. Reasoning upon these data the author was led to construct what he terms a "lightning bridge," which he constructs in the following way:—

Two thick metal conductors, terminating in points, are inserted usually in a piece of wood. These points approach one another within about 1-18th of an inch in a chamber cut in the middle of the wood.

This bridge is placed in the electric circuit in the most direct course which the lightning can take, and the space separating the two points is filled loosely with powder, which is placed in the chamber, and surrounds and covers the extremities of the pointed conductors.

The powder employed consists of carbon (a conductor), and a non-conducting substance in a minute state of division.

We have now to consider the behaviour of the lightning bridge in a circuit struck by lightning.

The lightning finds in its direct path, not a space of air, but a bridge of powder, consisting of particles of conducting matter in close proximity to one another; it connects these under the influence of the discharge, and throws the particles into a highly incandescent state. Incandescent matter offers a very free passage to electricity, and the secondary current developed by the demagnetisation finds an easier passage across the heated matter than through the coils of a telegraph instrument.

The reason a powder consisting entirely or chiefly of conducting matter cannot be safely employed, is that, although in the ordinary conditions of things it would be found to oppose a practically infinite resistance to the passage of electricity of the tension of ordinary working currents when a high tension discharge occurs, the particles under the influence of the discharge will generally be found to arrange themselves so closely as to make a conducting connection between the two points of the lightning bridge. This can be experimentally demonstrated by allowing the secondary currents developed by a Rhumkorff's coil to spark through a loose mass of blacklead.

Mr. Varley made the following experiments to test the resistance opposed to the passage of electricity by powdered conducting matter:—

Two crucibles were filled with blacklead powder (the best commercial blacklead used for domestic purposes). Two crucibles were filled with powdered charcoal, obtained from a charcoal dealer. The battery poles of a 12-cell sulphate battery were placed half an inch apart in the powders, a horizontal galvanometer being included in the circuit, and no deflection was obtained either with the blacklead or the charcoal powder; the galvanometer employed gave a deflection of 50 deg. with 12 cells through a resistance of 65,000 ohms. The crucibles were then heated to a full red heat, and the poles of the 12-cell battery placed in the heated powder, and the resistance opposed by the heated powder in each crucible measured. The wood charcoal gave a resistance never exceeding 7 ohms. The blacklead gave a resistance never exceeding 6 ohms. The crucibles were then removed from the fire and allowed to cool, and tested again some days afterwards; the powders were now found to conduct when cold. The wood charcoal powder gave a resistance continually varying and ranging between 2,000 and 500

ohms. The blacklead gave a more constant resistance, ranging between 400 and 100 ohms.

Mr. Varley concluded from this that the effect of highly heating charcoal and blacklead appears to be to make the particles more dense and to bring them closer together, so that they conduct.

It seems highly probable that had Mr. Varley been engaged as a scientific witness in the late trials, some very interesting information concerning the behaviour of carbon in different forms under various conditions might have been elicited, as it is hardly probable that his experiments did not lead him to think of it in connection with matters other than that of his lightning bridge.

A great deal has been said about Clerac's tube of carbon for obtaining variable resistance, and we believe that it was in use before Mr. Varley's invention; still, we think that in justice to the researches of the latter, we should not allow the matter to be unheralded because at the time it formed the subject of no particular praise or called for much remark in scientific journals.

THE TELEPHONE INDUSTRY.

Mr. Fawcett, speaking in the House of Commons last Saturday, said :—"It was desirable also that he should remove all doubt as to the relations of the Government to the telephone companies, as there had been a great deal of speculation on the chance that the Government would purchase them. It was as well that the truth should be known, for he believed that it was altogether improbable that the Government would do so. Their policy was to encourage free competition. If the thing could be done best by private companies he could only say he should be delighted to see the whole telephone business of the country conducted by private enterprise. If, on the other hand, it was proved that the business was better done by the Government, the Government would have beaten the companies in the open field of competition, and could occupy the ground without being subject to claims for compensation."

We are pleased at the attitude taken by the Postmaster-General in this most important matter, and if the private companies can only have fair play, we may shortly hope to see an immense development of such a necessary adjunct to our business relations as the telephone. There are, however, several obstacles to be overcome, the chief one being the monopoly at present possessed by the United Telephone Company—at least in their own ideas. Even here the stumbling-block appears to be not so much in the receiving instrument as in the transmitter. A great difference of opinion still exists as to the amount of ground covered by Mr. Edison's single claim, and yet another battle must be fought over this subject. As far as we understand this Edison patent for a transmitter or tension regulator, it is limited in its character; but we believe that the United Telephone Company think it covers any semi-conductor placed in between any two points of a circuit, no matter how connected, or how constructed, as long as the impulses of the voice are directly employed to change the positions of the atoms composing the semi-conductor, and thus to vary the resistance of the circuit. This unsatisfactory state of affairs will, however, it is to be hoped, shortly be placed on a proper footing; for until such is the case, it is almost hopeless to suppose that the telephonic industry can make any great advance, even on the strength of the licences recently granted by the Postal authorities.

The telephone is no longer a novelty, yet we think our readers will be somewhat surprised at the table we now place before them.

We extract from the New York *Review of the Telegraph* [illegible] *Telephone* of July 15th, the following statistics of the [illegible]ss made in seven countries of Europe. Number of [illegible] subscribers in actual operation in Europe :—

IN FRANCE.

Name of Town.	Name of Corporation or Co.	No. of Subs.
Paris	Société Générale des Téléphones	1,780
Bordeaux	,, ,,	178
Havre	,, ,,	114
Lille	,, ,,	26
Lyons	,, ,,	269
Marseilles	,, ,,	175
Nantes	,, ,,	78

IN ENGLAND.

London	United Telephone Company	1,561
Manchester	Lancashire & Cheshire Telephone Co.	650
Liverpool	,, ,, ,,	510
Barrow	,, ,, ,,	19
Preston	,, ,, ,,	17
Blackburn	,, ,, ,,	52
Burnley	,, ,, ,,	33
Wigan	,, ,, ,,	18
Accrington	,, ,, ,,	26
Warrington	,, ,, ,,	12

IN AUSTRIA.

Vienna		334

IN SWITZERLAND.

Zurich	Zurcher-Telephon-Gesellschaft	378
Basle	Gouvernement fédéral	235
Berne	,, ,,	157

IN BELGIUM.

Brussels	Company Belge du Téléphone Bell	402
Antwerp	,, ,, ,,	651
Liége	,, ,, ,,	329
Verviers	,, ,, ,,	189
Charleroi	,, ,, ,,	200
Ghent	,, ,, ,,	190

IN ITALY.

Turin	Société Générale Italienne des Téléphones	310
Genoa	,, ,, ,,	348
Sampierdarna	,, ,, ,,	30
Milan	,, ,, ,,	244
Venice	,, ,, ,,	68
Florence	,, ,, ,,	65
Livorne	,, ,, ,,	54
Bologne	,, ,, ,,	83
Rome	,, ,, ,,	389
Naples	,, ,, ,,	182
Palermo	,, ,, ,,	90
Messini	,, ,, ,,	17
Catane	,, ,, ,,	10

IN GERMANY.

Operated entirely by the Government.*

Berlin	,, ,, ,,	581
Breslin	,, ,, ,,	63
Cologne	,, ,, ,,	81
Elberfeld	,, ,, ,,	11
Frankfort	,, ,, ,,	179
Hamburg	,, ,, ,,	606
Leipsic	,, ,, ,,	142
Madgebourg	,, ,, ,,	48
Mannheim	,, ,, ,,	139
Mulhouse	,, ,, ,,	100
Stettin	,, ,, ,,	Don't know
Strassburg	,, ,, ,,	,,

As the above statistics stand it would appear that private companies, and not the government, should have the telephone business; but as yet so little has been done in Europe that the data we have at command is scarcely sufficient to allow of the deduction of any decided opinions.

We will now leave our readers to compare the respective telephonic industries of these countries, and we shall look forward to the time when we are able to state that England holds the leading position in this branch of electrical work, which she does at the present moment in regard to the telegraph.

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* Price of each subscription is same in every town, viz.: 200 marks (50 dollars), up to 2 kilometres and 50 marks (10 dols.) for each additional kilometre from the Central Bureau. To have a second or additional instrument in the same house and on the second line, the price is an extra 50 marks (10 dols.).

An income of 403,853,474 dols. during the year ending with June, 1882, was more than the government has received during any previous year since 1867, and the cost of the government, including pensions, was but 187,630,093 dols., leaving a surplus of 144,966,937 dols. after the payment of 75,258,439 dols. interest on the national debt. Unfortunately, the pension payment will be very heavy this year; but the interest on the debt will be 13,896,329 dols. less than it was last year. The customs receipts, the greatest [illegible] last year in all the history of the nation, 219,986,223 dols., [illegible] would be sufficient to maintain the government and slowly reduce the [illegible] national debt, were the internal revenue and income from [illegible] miscellaneous sources wholly to cease.

THE EDISON ELECTRICAL ESTABLISHMENT AT IVRY.

[We are again indebted to the courtesy of M. le Comte du Moncel for advanced proofs of the above interesting article, which appears in our contemporary *La Lumière Electrique*. Unfortunately it arrived too late for insertion in our last week's issue.]

The finest electrical establishment at present in existence in France, both as regards the size of the building and the plant, is that which has just been started at Ivry, near Paris, by the Edison Light Company. It belonged formerly to M. Alexandre, and was used for the construction of organs and pianos, and it is built in a part of the old park of Ivry. Besides the principal part of this establishment, which forms a large courtyard built in on every side, there are several wings of four storeys placed parallel and perpendicularly all round, which give to the whole the appearance of an admirably planned manufacturing city on a small scale. It is in these wings that the various machines are placed which are required for the manufacture of the apparatus which enters into Edison's system of electric lighting.

In one wing we find the lathes and tools necessary for the construction of the dynamo-electric machines of the Edison system. Several models are constructed which can individually maintain series of 17, 60, 100, 125, 150, 250, 500, and 1,200 lamps. Each part of these machines is manufactured in a certain workshop, and the coiling of the wires which necessitated special arrangements is performed in separate rooms.

In several other wings are the workshops devoted to the manufacture of the lamps. In one we see little blades of bamboo which come from Japan in boxes, and then pass through several hands to be reduced gradually to the required thickness, which is that of a sheet of paper, and at last cut so as to present the appearance of a slender filament, perfectly formed and terminated at the two extremities by a sort of expansion, by means of which it is fixed to the wires of the circuit. These different operations necessitate several workmen, who pass to each other in succession the blades of bamboo as they are fashioned, and the work is performed with machines admirably constructed and convenient to manage. In another part of the establishment the carbonisation of the filaments is performed. They are first put into little flat moulds, hermetically closed, which bend them into the shape of a horseshoe; and these moulds are so arranged, that during the carbonisation, which necessarily reduces the length and thickness of the filament, the horseshoe shape is constantly maintained. These moulds are then placed in graphite cases, hermetically closed, and these cases are in their turn put into furnaces heated to a high temperature. An entire building is set apart for this process, and the furnaces are constructed on an excellent model and simplify the work considerably.

The glass bulbs of these kinds of lamps are made in another part of the establishment, and their manufacture is effected in two different workshops. In one are constructed the glass tubes through which the platinum wires are fuzed, to which the extremities of the carbon filaments are to be attached; in the other are manufactured the bulbs into which these tubes are to be introduced with their carbon, and which are to be exhausted of air. It is curious to see with what promptitude these various operations are effected; and one can now easily understand that 500 of these lamps can be made in a day.

But what especially excited my curiosity is the manner in which the vacuum is obtained; it is quite an installation of a physical laboratory. Imagine in a large hall a sort of long enclosure, closed by three partitions about 2 metres high, and on the walls of which are externally placed in series 500 mercury barometer tubes, of a construction somewhat analogous to that employed by Sprengel; imagine adjusted to each of these tubes a lamp with its bulb not yet closed, and in the middle of the space enclosed by the partitions two large tubes of cast-iron, about 20 centimetres in diameter, communicating with the 500 tubes and connected with an enormous vacuum pump of Sprengel, and you will be able to form an idea of the importance which has been given to this process. The process of exhausting these lamps is, as has been often said, extremely important and very delicate; for not only should the vacuum prevent the combustion of the carbon filament, but it should also increase its tenacity. This is why it is necessary to proceed by several successive operations effected after longer or shorter intervals of time, during which the filament is rendered incandescent under the influence of a more or less powerful current. Thus the gases contained in the pores of the carbon are set free, its density increases, and its tenacity becomes sufficiently great to be comparable to that of a metallic wire.

Under these conditions filaments of carbon of the thinness of a hair can resist powerful jerks communicated to the lamp, and are not appreciably changed by incandescence. It is by this means that the lamps now used in the Edison system are warranted by the company to last 800 hours. There are besides many which have lasted nearly double that time, and it is even asserted that the mean duration is 1,200 hours.

One of the most important conditions of the Edison system is the complete uniformity of resistance of the carbonised filaments; therefore an entire testing apparatus has been arranged for the measurement of this resistance by the Wheatstone bridge and the Thomson mirror galvanometer. A dark room is used for this purpose, and as the filaments are manufactured, they are sent to the operator and classified according to their resistance. The carbons of the 16 candle-power lamps have a resistance of about 140 and those of the 8-candle lamps a resistance of 70 ohms. However, some are now constructed which have a resistance of 280 ohms, and which are made to give a light of 10 candles.

These carbons have the advantage of allowing of a greater division of the light from the same dynamo-electric machine, and this can be easily understood if we reflect that the total resistance of the outer circuit, which should be about equal to that of the machine, would become much less than the latter, if the number of derivations became too great, and in order then to obtain the equality of the two resistances, the resistance of each derivation must be increased. The measurement of the resistance of the carbons is not all that is done in the hall of which we are now speaking; the photometric measurement of each lamp, under the influence of a given and constant current, is also taken. For this purpose the Bunsen photometer is used, and for a standard light, a Carcel lamp, arranged on a balance, is employed, so that the quantity of oil consumed per hour can be measured. All these measurements are noted, and the lamps are grouped into different divisions, according to their resistance and intended luminous intensity.

Other workshops are also set apart for the joining of the carbon filaments to the platinum conductors, and for mounting the lamps on their supports. We know that the platinum wires are terminated where they meet the carbon by two little plates, arranged like the jaws of a vice, and between these plates are introduced the appendages which terminate the filament. In order to insure good contact, they are electro-coppered, and the joint becomes permanent. For this purpose several baths are placed separately in a room, and in each bath a great number of these joints can be coppered simultaneously. The plaster mounting of the bulbs on to their support is also done quickly and very simply, so that all the elements which enter into the construction of the Edison lamps are manufactured in the establishment. Only the fittings, suspensions, brackets, and candelabra of bronze, are left to Parisian industry, but they are constructed according to the models sent from America.

Besides the workshops of which we have just spoken, there are others set apart for the manufacture of the conductors, of different diameters, intended to supply electricity to the lamps through streets and houses. This department has only just started, and has not as yet the importance that it will have in the future; but it has necessitated a vast amount of space, and several buildings adjacent to the establishment will be employed for this work. We must also mention among the various departments of this industry, the rooms for designs of machines and of installations, rooms for packing, saw-mills, forges, and experimenting rooms, in which are placed steam-engines of great power.

The whole installation has been effected in six months, under the able direction of Mr. Batchelor, Mr. Edison's collaborateur, who is the engineering electrician to the com-

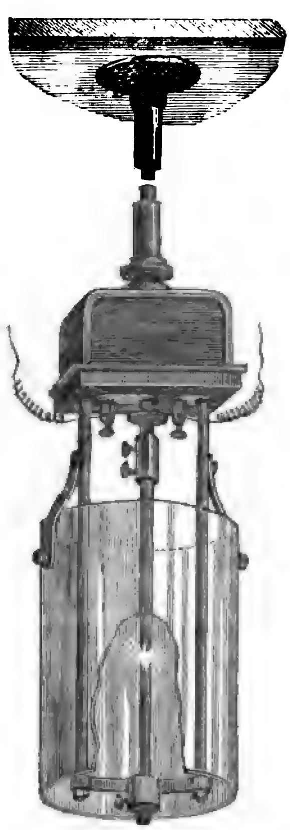
pany. It will not, however, be completed until the latter end of the year. We see that, unlike what has been done by many electric lighting companies, the one of which we speak is more interested in the practical side of the question than the financial, which is a safe guarantee of the reliability of the enterprise. Besides, it is known that already several installations have been established in various European towns, and we know that the company is receiving every day orders for France. As they are now in a position to carry them out, it is probable that we shall very shortly be able to judge for ourselves of the advantages of this system of lighting.

TH. DU MONCEL.

ELECTRIC LAMP.

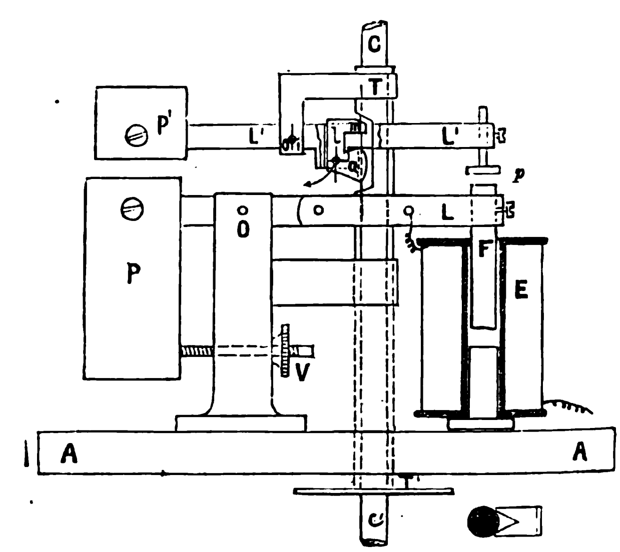
ROBERT MONDOS' SYSTEM.

This electric lamp has lighted the concert-hall of the Champs Elysées since the 1st May last, and an indefinite number of burners can be placed in one circuit, according to the electromotive force of the generating machine. The regulation is founded on the principle of derivation, the inventor having determined to dispense with all clockwork and all antagonistic springs, and has so arranged his apparatus that a single electro-magnet performs the two distinct functions of making and regulating the arc. The lower carbon is fixed on a strap suspended to the box containing the mechanism, the displacements of the movable upper carbon effect the lighting and maintain the fixity of



the arc. The mechanism represented in the diagram comprises an electro-magnet, E, the cores of which only occupy part of its length, about one-third; inside the coils, two rods of soft iron, F, suspended to a horizontal lever, L, turning at O and balanced by a weight, P, move freely. The screw, V, serves to limit the movement of the lever, L, to which is suspended a tube, T T′, traversed by a solid rod, C C′, which supports the movable carbon suspended to its lower extremity. The carbon holding rod, C C′, can slide freely into the tube, T T′, but it is prevented from doing so by a brake, *m*, *l*, *a*, the two extremities of which, *m* and *a*, in the form of a V, grip the rod, C C′, and hold it by friction in the tube, T T′. For this purpose, the tube, T T′, has an indentation opposite the brake. This brake is fixed on a lever, L′, L′, turning at the point, O′. The movements of the centre, O′, are distinct from those of the tube, T T′, on account of the square, T O′; the lever, L′, has an armature of soft iron, *p*, placed opposite the cores, F, and the action which the cores tend to exercise on this armature is counter-balanced by the weight, P′. When the apparatus is at rest the carbons are separated and the brake, *l*, *m*, *a*, maintains the rod, C C′, firmly held in the tube, T T′.

At the time when the current is sent into the apparatus, the carbons being separated, the current passes entirely into the coils, E, the rods, F, are powerfully attracted, the lever, L, swings and makes the entire system descend, whereas the armature, *p*, being powerfully attracted, loosens the brake and enables the rod, C C′, to descend freely until the two carbons come in contact. At this moment, the carbons being in contact, the current passes almost entirely through the main circuit, the power of the electro-magnet diminishes considerably; the levers, L and L′, then swing in an opposite direction under the action of the weights, P and P′, the entire system is raised and the arc is formed. As the arc lengthens in consequence of the consumption of the carbons, the current which passes through E increases in power, the cores, F, are more powerfully attracted, they attract the armature, *p*, with more force; the lever, L′, then tends to swing in the direction of the hands of a watch, the point of attachment of the brake, *l*, *m*, *a*, tends to recede from the rod, C C′, and consequently to loosen the brake which allows the rod to slide, and so shortens the arc. Practically the movement of L′ is inappreciable, and the rod, C C, slides by its own weight slowly and continuously. During this process of regulation the part, L, is immovable on account of the heaviness of the weight, P, and it only swings at the moment of lighting, when the arc is broken and the carbons separated. The regulator we have just described works with continuous or alternating currents as occasion may require. At the concert-hall at the Champs Elysées the burners are worked by an alternating current Siemens' machine; there are sixteen of them arranged in four distinct circuits.



The little vibrations produced in the mechanism by the alternating currents are very favourable to the working of this system, in which the carbon-holder is maintained by the friction of the rod between the tube and the brake. The apparatus can work with currents of very different intensities without changing any part of its mechanism.

In order that this object may be effected, the distance of the counterweights, P and P′, from the centres of the levers, L, L′, is adjustable; and, moreover, the relative position of the movable bar, F, and the armature, *p*, can be altered so as to obtain a very delicate adjustment.

At the concert-hall of the Champs Elysées [illegible] the lamps work normally with carbons 10 mm. in diam[illegible], a current of 10 ampères, and a difference of potenti[illegible] of 60 volts at the terminals of each lamp. The light pre[illegible]sents very great steadiness, and the mechanism is so simple [illegible] that the system has worked up to the present without any [illegible]itch.

TELEGRAPHS IN CHINA.

[We find the following article in the *Shanghai Courier*, and as we also receive private information that the facts are authentic, it may be of interest to many of our readers, and to all it will form a relief to the ever-recurring topic of electric lighting.]

Now that a land line of some 900 miles in length, connecting Tientsin with Shanghai, is erected and open for the transmission of public messages, it may be worth while to examine the future prospects of telegraphic enterprise in this country, and to view the probabilities of further extensions. This line, with a line from Tientsin to Taku and Peh Tang, is, we believe, the property of the Chinese Government, and is managed exclusively by Chinese officials, and worked by some six or seven operators of the Great Northern Telegraph Company. The erection of the line was entirely due to the scare induced by the anticipated war between Russia and China in 1880-81, and the money granted for the cost of construction was voted by the "Imperial Defence Bureau."

It is somewhat curious to speculate as to the reason why the long-shown antipathy of the Chinese Government to telegraphs was gradually swept away from the celestial mind. Up to the year 1876 the most violent dislike to anything telegraphic, necessitating posts and wires, or any visible obstruction to the beneficent influences of Fung Shui, was always manifested—witness the prolonged but abortive attempt of the Great Northern Company to erect a land line from Foochow to Amoy. But in 1877 a distinct change in their policy took place. As soon as the Chinese Government found it possible that native clerks could be taught to work the Morse telegraph instrument, and native workmen could erect land lines, permission was given to build a line, and a line was accordingly built from the Viceroy Li Hung Chang's Yamen to the Torpedo College, by Mr. Betts, the torpedo engineer to the Chinese Government. This was speedily followed by a line from Tientsin to the numerous forts at Taku and Peh Tang. The great convenience of this line was at once apparent to the Viceroy, for military orders could be transmitted and a reply received immediately. The first official message sent over the line was an order from the Viceroy to the Commander of the forts, to "dress" the forts and men-of-war, and fire a salute of twenty-one guns on the arrival of the U.S.S. *Ashuelot*, with General Grant on board; and to report the vessel on being sighted at Taku.

In 1880 it was decided to connect Shanghai with Tientsin for the purpose of enabling Li Hung Chang to receive news from the outer world and to confer with his colleague at Nankin, with a view of devising measures for the defence of the Yangtse from Russian attack. The Great Northern Telegraph Company obtained the contract to build the line, and at once commenced work. Without the slightest opposition from the people the line was built and opened for traffic in December, 1881; a marked contrast to the attempt at Foochow in 1874-5, where, after two years of futile efforts, the line was abandoned.

An extension from Chinkiang to Nankin has been determined upon, and further extensions are projected. If these extensions are carried out they will have a very important bearing upon the value of foreign cable property in the Far East. The next line which is proposed is from Nankin to Hankow, and if this line is built it will no doubt act as a very valuable feeder to the cables in the tea season; but should the contemplated extensions to the South of China be carried out, and the lines remain in the hands of the Chinese Government, it will inflict a very serious blow to the prosperity of the Great Northern cables.

The Great Northern Telegraph Company at present have cables from Hongkong to Shanghai (looped into Amoy), thence to Nagasaki, thence to Wladivostock, where the cables join the Siberian land lines. These cables were laid in 1870, are technically known as "Hooper's" core, and vary from 1½ tons to 18 tons per knot. The insulation of the cables is said to be in a very bad state, so bad that heavy battery power is employed on some sections, and break downs, as we all know, are of frequent occurrence. In January of the present year the cable was broken in three places at the same time, viz,, south of Gutzlaff, north of Gutzlaff, and between Shanghai and Gutzlaff. These faults had not been repaired more than a week or two when, on February 12th, the cable was again broken near Amoy. Before the cable ship could return to Shanghai after repairing the fault, the cable was again broken between Shanghai and Nagasaki. This two months' state of affairs may be considered but a fair sample of the condition of these cables, and in no way exceptional. Naturally much dissatisfaction is felt by the Shanghai public at these constant interruptions, and coupled with the angry feeling caused by the excessively high word-rate, would lead it gladly to use any alternative route if open to it. Should the Chinese extend their land lines to Canton and thence to Hongkong, such a route would be opened, and the European traffic would undoubtedly pass over the cables of the Eastern Extension Company; while of the local coast traffic, at least the greater portion would be diverted from the Great Northern cables (even when working to the Chinese land lines).

It is no doubt a consideration of these facts which is so strenuously urging the Great Northern Company to attempt to obtain from the Chinese a concession for the construction of land lines in China.

A land line from Shanghai to Canton, thence to Hongkong, in their own hands would practically duplicate 1,000 miles of cable, south of Shanghai; while a line from Tientsin to Pekin and thence to Kiachtka on the Siberian frontier, would duplicate about 1,000 miles of cable and some 1,200 miles of land lines, as far as European traffic is concerned. As these cables must sooner or later be renewed, at an expenditure of some £300,000 sterling, unless the control of the land lines can be obtained, the importance of the question to the Great Northern Telegraph Company cannot be overlooked, and it is certainly to be hoped that in the interests of the world at large, and Shanghai in particular, the land lines may be built, whether by the Chinese Government or the Great Northern Company is a matter of small importance to the public, so long as the residents in Shanghai have some reliable means of getting a message through to Europe.

THE MAGNETO-SOUNDER.

FIELD TELEGRAPH WITHOUT BATTERY.

In certain special cases, under favourable conditions, the telegraph lines can be extended to battle-fields. However, notwithstanding their lightness, they cannot be moved easily enough to follow up the manœuvres, and very frequently their fragility would render their preservation a matter of great difficulty in the midst of military operations.*

On the other hand, it must be admitted that it would be useless and impossible to use the telegraph at a distance less than six kilometres from the front of an army in action; useless, because, it would be quicker to send messengers; impossible, because it could not be worked under fire. However, for communication between the main guard and the sentinels, or between the batteries and the posts of observation, endeavours have been made to fit-up light telegraphs, capable of being conveyed by a few men; these may be called advanced post telegraphs. Each installation generally contains one kilometre of cable, which enables lines two kilometres in extent to be filled up between two stations.

At the time of the discovery of the telephone it was thought that this new instrument was destined to take the place of these telegraphs. But the experiments during the Russo-Turkish war soon showed that the noise of an army almost always, except in the silence of the night, prevents the voice from being heard. The most perfect telephones were however known at that time, those constructed by Siemens at Berlin and by Gower at Paris.

The microphone even does not amplify the sounds sufficiently to render them perceptible under all conditions. It requires a battery, which is cumbersome and necessitates a certain regulation of position in relation to the vertical,

* "La Télégraphie Electrique de Campagne." By Van den Bogaert, officer of the Belgian Engineers.

which is inconvenient. Finally, it must be placed on a fixed stand, for it produces deep sounds when vibrations are communicated to its support. It has therefore been rejected altogether; as to the telephone, it has been admitted that under certain conditions, it can be of service, and in the greater number of armies, it has been added to the light telegraphs already in use. The following are some of the different systems.

(A.)—Systems with Permanent Signals.

I.—*The Prussian Telegraph of Bückoltz*, employed by the Company of Belgian Campaigning Telegraph Operators. This apparatus has a return wire and is worked by a continuous current, *i.e.*, when there is no transmission, the current passes through the line and gears the clockwork mechanism: the signals are then produced by the interruption of the current, which throws the mechanism out of gear. Consequently, directly the cable is cut, the operators become aware of it.

The instruments work together, *i.e.*, the despatch is recorded simultaneously at the two stations. A recent improvement enables us to pass from the continuous current to the ordinary current by means of a commutator.

A complete installation comprises:

(1.) A case $0^{m.}\ 15 \times 0^{m.}\ 14 \times 0^{m.}\ 15$, containing the galvanometer and the manipulator. The last model is somewhat larger.

(2.) The battery, consisting of 12 Siemens elements with sulphate of copper. It weighs 12 kilogrammes.

(3.) Two coils of 500 metres of cable with two wires, one carried in a sort of infantry bag, the other in a case.

II.—*The Russian System of Dereviankine* is very similar to the above; the earth is employed as return conductor.*

Remarks.—The field telegraphs of Bückoltz and Dereviankine are the only ones that give permanent signals. They are excellently arranged; we think it would be impossible to condense any further the component parts, which are essential if we wish to keep copies of the despatches; but this does not seem to be altogether necessary. In America, on almost all the permanent lines, the despatches are sent by sound alone, and in campaign telegraphy it is very seldom that important orders are transmitted of which it is necessary to keep a copy.

(B.)—Systems with Momentary Signals.

(*a.*) *Optical Telegraphs.*

I.—*Trouvé System.*—This is only a miniature, about the size of a large watch, of an ordinary dial telegraph, with simplified mechanism. The receiver is worked by clockwork; the manipulator is worked by a button similar to that in keyless watches. The wet battery and a kilometre of cable are placed on a yoke to be carried on a man's back.†

II.—*Wheatstone One Needle System* (in use in the Spanish army).—It comprises as a receiver a vertical galvanometer, the needle of which deviates to the right or to the left, according to the direction of the current transmitted. The deviations to the left form the dots, and those to the right the dashes of the Morse alphabet. The manipulator, which resembles all those of the Morse type, is worked by reversals of the current; it is placed above the galvanometer, which is only 8 or 9 centimetres in height.‡

III.—*Prussian Needle Telegraph with Earth Battery.*—This system is similar to the preceding one; the current is supplied by two pieces of zinc and copper, which are buried in the damp earth. It was used during the war of 1870.§

Remarks.—The Trouvé system is very delicate; the two others are more solid and better suited to military operations. But it is very difficult to read the Morse signals indicated by a needle, and it cannot be used at night. As a sound can be heard at any time, sounders are preferred to the above instruments.

* Paris Exhibition of 1881, No. 1,700 in the catalogue.
† *See* Du Moncel. "Les Applications de l'Electricité."
‡ "Minas Hydraulicas Defensivas," por el Coronel Scheidnagel.
§ Laurencin, "Le Télégraphe."

(B.)—Sounders.

I.—*The Caton Sounder* (employed exclusively in the military telegraph of the United States).—It is simply an electro-magnet, the armature of which forms the sounder. It is contained together with the manipulator in a little case, $0^{m.}\ 15 \times 0^{m.}\ 06 \times 0^{m.}\ 04$.

The battery employed contains several elements with sulphate of copper.

II.—*The Sounder of the French army*, smaller in size but similar to the preceding one, employs a wet battery or a reversible one.

III.—*Dereviankine's Russian Sounder*, also similar to the Caton sounder, is only $0^{m.}\ 10 \times 0^{m.}\ 08 \times 0^{m.}\ 05$.

IV.—*The Spanish Sounder*, with dimensions similar to those of the French sounder.

V.—*The Trouvé Sounder* has the appearance of a large watch. The accessories are the same as those of the portable telegraph by the same inventor.

Remarks.—All these sounders have the inconvenience of requiring a somewhat powerful, and consequently cumberous, battery. The Trouvé battery is the lightest, but the apparatus worked by it has rather a limited value. At the time when it was shown by experiment that the telephone was of little use to reproduce speech at the vanguard of an army, it was found that under the influence of battery currents, and especially of the high tension currents of induction coils, this apparatus gave sounds of great intensity. When a current is sent into the circuit of a telephone the magnetism of the magnet which constitutes it varies, and the result is a variation in the action of this magnet on its diaphragm of soft iron. Two different sounds are then heard, one when the current is established, the other when it ceases, and thus long emissions can be distinguished from short ones, as in the Morse sounder.

In order to produce a sound of greater intensity, serving to warn the correspondent that the transmission is about to commence, the interrupted current of a little Ruhmkorff coil is employed; a continuous current can also be sent into the line, the interruptions being produced by the plate of the telephone itself, by arranging it like the armature of a trembling bell. (Captain Ferrodon's alarm.)

The instruments constructed according to the above principles are:—

(C.)—Telephonic Sounders with Battery.

I.—*The Racagni-Guglielmini System.**—These inventors arrange their induction coil either in the handle of one of the telephones, which also contains the manipulator, or on the reversible battery, which has the form of a cartridge-box. They employ an electro-chemical receiver with paper band, which seems to have the drawbacks of the Morse system without possessing its advantages.

II.—*The Mangenot System* is identical in principle with the preceding one. The battery is also in the form of a cartridge-box, and contains the manipulator and the induction coil. The inventor, acknowledging the inconvenience of his battery, which is never hermetic, and which becomes polarised, proposes to substitute for it a Clarke machine, weighing $2^{kg.}\ 500$. In the event of it being impossible to hear sounds, he proposes to receive by the sense of touch, by placing the lips on the terminal of connection of the telephone. It will be remembered that a very skilful telegraph operator in 1870 received a message in this manner across a cable submerged under the Seine; but this was really a feat which would require no common degree of skill to perform.

Remarks.—All these instruments have the drawback of requiring cumbrous batteries, which the slightest accident would render useless, and which require great care. M. Mangenot proposes to substitute for them an induction machine, which is too heavy and which presents the great disadvantage of requiring a man to turn the handle. The solution of the problem must evidently be sought for among the following instruments:—

(D.)—Telephonic Sounders without Battery.

I.—*Colonel Jacobi's Télékal.*—The complete installation comprises a long-distance telephone, and a case $0^{m.}\ 21 \times 0^{m.}$

* Electrical Exhibition of 1881, Italian section, No. 1,605.

$11 \times 0^{m\cdot}33$, weighing from five to seven kilos., and called the *Télékal.** It is furnished with a Morse manipulator, worked in the ordinary manner; by means of a little handle the manipulator can be made to ring so as to call the correspondent.

We can also employ for this purpose the trumpet call with which long-distance telephones are supplied, whether constructed by Siemens or by Gower.

The advantages of the télékal are, according to the inventor, that it can be worked without battery to considerable distances, far beyond the limit at which the voice can be heard without being affected by the telegraphic transmissions of neighbouring wires or external noises. It requires no regulation of position like the microphone, and is of great solidity.

We have in vain sought for information on the principle of this apparatus; its inventor preserves absolute silence on this subject.

II.—*The Magneto-Sounder.*—It seems to us that the télékal was still very heavy and very bulky. We have therefore sought after an apparatus which should offer the same advantages, but have less weight and less bulk. Fig. 1

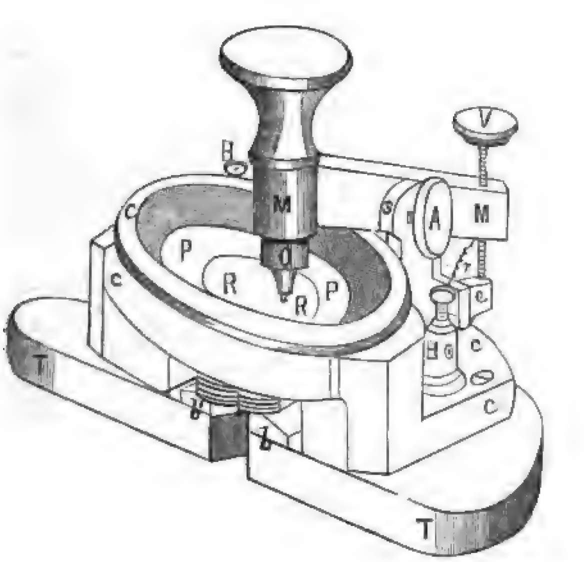


Fig. 1.

represents the arrangement at which we have arrived. A plate of soft iron, P P, is firmly fixed into a frame of copper, c c c, facing the poles of a flat horse-shoe magnet, T T, similar to those of the Gower telephones (*see* fig. 2). These

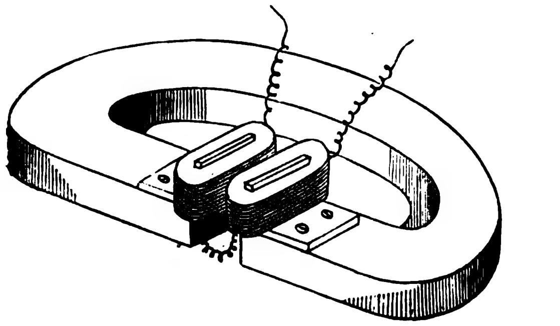


Fig. 2.

poles are, as we know, placed opposite one another, and very close together; on each of them is screwed a little square of soft iron, enveloped in a coil of very fine insulated wire. This wire is coiled in such a manner that the current passes in a contrary direction in the two coils.

The two free extremities of the wire are soldered on to the terminals, B B, the plate, P P, has a projection, *i.e.*, it bulges out in the centre so as to be elastic under pressure like metallic castanets. This pressure is produced by a small Morse lever, M M, supported by the projection, S, of the frame of copper, c c c, by means of the axle-screw, A; V is a regulating screw which serves to limit its play, and r, an opposing spring.

The apparatus thus constructed only weighs 250 grammes more than the magnet which forms part of it, or 750 grammes in all. It can be contained in a box, $12^{c\cdot}5 \times 9^{c\cdot} \times 5^{c\cdot}$, only the button of the manipulator, and the two terminal screws, B and B′, being left out.

In order to use it the terminal, B′, is connected to the line, and B to one of the poles of a Bell telephone, the other pole being connected to earth, as is shown in fig. 3.

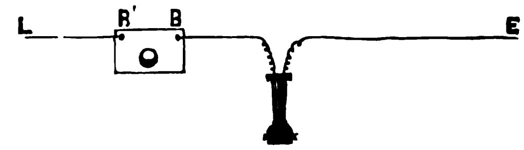


Fig. 3.

When used in active service, the magnetic sounder is suspended on the breast by a strap, and the hilt of a sword stuck into slightly damp soil forms an earth. The operator then works with his right hand as with the Morse manipulator, and applies the telephone to his ear with his left hand. In order to make the working of the apparatus clearly understood, we must first explain that of an ordinary telegraphic sounder.

In the written Morse alphabet, the different letters are represented by combinations of dots and dashes. The telegraphic receiver reproduces these dots and dashes on a slip of paper by the pressure, more or less prolonged, of the armature of an electro-magnet, which is lowered every time the current passes through, and is raised by means of a counteracting spring. In this system ·— represents *a*.

It does not work in this manner when the signal is received by the ear. The movement of the armature is limited by two stops, when it falls it strikes one of them and produces a sound, when it rises it strikes the other and produces another sound. We can therefore note the duration of the time it is lowered; if very short the two different sounds interfere with one another. Thus *a* is represented by (●×) ● × if we represent by ● and × respectively the sounds of the falling and rising of the armature.

In the *magneto-sounder* the transmitting mechanism is identical with what we have just described. When the plate is brought towards or drawn away from the coils a current is produced in them arising from the increase or decrease of the magnetic action on this plate acting as an armature. Currents are thus sent into the line and produce sounds in the receiving telephone.

The apparatus constructed by Richez & Cie., at Brussels, has fulfilled all our expectations. We have tried it on a telephonic line and were able to correspond freely. We introduced 6,000 Siemens units, *i.e.*, about 600 kilometres of telegraphic iron wire 4 millimetres in diameter into the circuit without producing any appreciable effect on the clearness of the sounds received; we had no further resistances at our disposal, but everything led us to believe that experiments made on long lines would be crowned with success. The new apparatus can, therefore, be substituted for the Morse sounder in all its applications. It has the advantage of being very light, of not requiring any battery, and of being extremely sensitive. Finally, it comprises a telephone which can be used in the ordinary manner.

The above description of the magneto-sounder for field telegraphs is an extract from the *Revue belge d'Art, de Sciences, et de Technologie Militaires, septième année* (1882), *tome* II., and is written by Lieutenant L. Weissenbruch.

* See the original description by the inventor in *La Lumière Electrique*, 3rd year, No. 35.

Danger from Electric Lighting.—We are informed that an inquest is to be held on the victims of the accident which we noticed in our "Notes" of last week as having recently occurred in the gardens of the Tuilleries in Paris. M. C. M. Gariel is charged with the technical part of the inquiry, and Dr. Bronardel with the autopsy of both bodies.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE PRINCIPLE OF CARBON TELEPHONES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In reference to the principle of carbon telephones I have made the following experiment, which, I think, will interest your readers. On one side of a block of gas carbon, 155 mm. long and about 30 mm. diameter, I bored two holes, 7 mm. deep and 110 mm. from each other. They were then filled with mercury, and the arrangement placed in circuit with a battery and telephone by means of *amalgamated* copper wires dipping into them. On striking the block with a ruler the blows were loudly heard in the telephone. The block was then placed on a piano, every note of which was distinctly audible; and even speech was faintly heard.

Yours faithfully,

F. DE WOLFFERS, FILS.

56, Portland Place, Clapham, S.W.

August 11th.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—It seems evident to me that Mr. S. Thompson, in his reply inserted in the last number of your journal, has not kept to the subject. He will allow me, in the first place, to tell him that I have for several years been well acquainted with the effects of imperfect contacts, even between metallic substances, and have studied them at various times since the year 1856. I sent you the analysis of these researches, which you were good enough to publish in your journal for the 10th of June; and it is because I have carefully studied these effects that I know that electrical variations, resulting from a more or less close adherence of the contacts, are more limited with metallic conductors than with imperfect ones. Therefore when I say that Reis's receiver with needles cannot reproduce speech loudly, I suppose the original transmitter of Reis to be used, and not any improved apparatus, such as those of Hunnings and Ader. It is certain that with good transmitters and a powerful battery articulate sounds can be obtained from a similar kind of receiver, and M. Ader's *speaking table*, which I have described in the two last editions of my work on the telephone (*see* p. 380 of the fourth edition, and p. 317 of the third) is a proof of this. I had even asserted this in the year 1878, at the time of my discussion with Colonel Navez, but what seems to me difficult to believe, is that this effect can be obtained with the metallic contacts employed by Reis. The question is not what can be done at the present day, but what could be done in 1863. Besides, experiment has shown M. Ader that his speaking table could only reproduce sounds at a very short distance—from one room to another, for instance.

On the other hand, while asserting that speech can scarcely be reproduced in Reis's needle receiver with his metallic contact transmitter, I will readily admit that it can be effected with this transmitter, if an improved Bell receiver be used, and if the receiver alluded to by Mr. S. Thompson, with which I am not acquainted, is under analogous conditions, I can agree with him. It would, however, still be very extraordinary that such an important discovery should not have had more publicity, and that our attention should have been called to it from America.

As to the principle of the variability of the intensity of currents with imperfect contacts when submitted to various pressures, Mr. S. Thompson will allow me to tell him that in the year 1874 I had asserted and *proved* that the actuating cause was the *variation in the closeness of the adherence* of the two contacts, and this hypothesis has been maintained lately by Mr. Thompson himself, and also demonstrated in 1879 by Mr. Barrett. But the field of electrical variations is more extended with bodies of moderate conductivity, as the effects are then due to several causes:—first, the more or less close adherence of the contacts; secondly, the amount of surface of the two conductors in contact, which is equivalent to a sectional variation; thirdly, the degree of subsidence of the molecules of the conductors in contact; fourthly, the different conditions in the gaseous medium interposed between the surfaces of contact, and, perhaps, even the various conditions of a *disruptive* discharge of the current, inappreciable to the observer, but perhaps producing an effect on the telephone. Recently experiments on these points have been undertaken by English *savants*, and I believe they help to elucidate this question, which is still obscure. But in my opinion it is certain that all these causes manifest themselves simultaneously, and to a greater or less degree according to the nature of the conductors, and the effects are more or less forcible according to whether the conductors are favourable to them or not; and this is why carbon transmitters, or those constituted of metallic ores or agglomerations of metallic filings, are the best for telephonic purposes.

TH. DU MONCEL.

Lebisey, *August 8th*, 1882.

THE POST OFFICE AND THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The public have read with extreme gratification that our Liberal Postmaster-General has relieved the telephone industry of the one difficulty which attended its extension, by promising to license the operations of all telephone companies.

Last winter I addressed a crowded meeting in the Theatre of the Society of Arts, under the presidentship of the Right Honourable E. P. Bouverie, on the subject of this industry and the great public benefits which would accrue from the wide extension of telephone exchanges throughout the land, at rates of subscription which would bring it within the reach of every one for social as well as commercial purposes, and still return a handsome profit to the undertakers.

In noticing the slow progress the use of the telephone exchange has made in the United Kingdom, in comparison with other countries, I showed the audience how the construction, maintenance, and working of the systems should be adapted to the wants and prejudices of the public at large, and how necessary it was to commence operations, so as to avoid the natural dislike of the community to the unsightliness and inconvenience of the ordinary poles and wires of our telegraphs, and, that the true way to overcome these obstacles was to enlist the public of each locality in the establishment of telephony for the use and convenience of the majority.

The application of this simple and naturally cheap help to the daily transactions of life is an infinitely easier matter than that of electric lighting, and yet we see the public investing deeply in those industries and almost neglecting the telephone industry altogether.

It can be easily shown that the establishment of a telephone exchange of one hundred subscribers, within a square mile, and costing each subscriber not more than 6d. a day, will safely pay an interest of more than 15 per cent. to the capitalist, after providing 65 per cent. for working, maintenance, and renewal expenses, and that every further extension in the same area will largely increase that return.

It is to be reaped in any part of the kingdom in which 100 persons, able and willing to subscribe 6d. a day for the convenience, can be found within a square mile. All experience in other countries shows that once introduced it spreads rapidly, and once established, it becomes a necessity, like water, light, &c.

The money value of the saving in labour to the community is far in excess in proportion to the value of the plant, in comparison with the saving arising for like reasons out of the use of the State telegraphs, because the average traffic is far more and the cost of manipulators is saved, as the public speaks its own messages.

A bill somewhat on the same lines as that for electric lighting would smooth any difficulties which are still encountered in the extension of the telephone systems, and

by cheapening the first cost to the companies undertaking the work, would also cheapen the service to the public. Bills of this kind have generally to be promoted by industries. The public cannot do better than support by their adhesion the companies which now appear to be springing up, with the object of extending true, cheap telephony. The ultimate reward to good work and good management is so secure, if the companies are established and worked on sound financial principles, that there is no industry which can offer fewer risks to the investor.

The objection to the public use of the fundamental principles of the invention, raised by the owners of patents, can never stand before the fair test of a scientific investigation.

All monopolies must fall immediately the public becomes aware that they are standing in the way of a great social necessity.

C. E. WEBBER,
President Society Telegraph Engineers
and of Electricians.

August 11th, 1882.

IMPROVEMENTS IN ACCUMULATORS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In the number of your interesting Review for July 29th you have described some experiments made with modified Faure accumulators, the results of which have been published in the *Annales de l'Electricité*.

In reproducing the general results alone, you accompany them with guarded remarks based on an inexact and incomplete understanding of acquired facts, which I can only explain by a bad translation.

You will allow me therefore, I trust, for the edification of your readers, to put the matter in its true light.

The following, to begin with, are the results of two published experiments.

A. An accumulator containing 3·145 kilogrammes of *minium* and 4 kilogrammes of lead was taken.

During	15 m.	a current of	10 amp.,	that is	2·5	amp. hrs.
,, the next	2 hrs.	,,	9½ ,,	,,	19·	,,
,, ,,	8 hrs. 15 m.	,,	9 ,,	,,	74·25	,,
,, ,,	15 m.	,,	6 ,,	,,	1·50	,,
	10 hrs. 45 m.		Total ...	...	97·25	

Or a current of 9 ampères during 10 hours.

In explaining the formula $\text{Tr} = \frac{\text{E I}}{\text{g}}$ we have

$$\text{Tr} = \frac{2{\cdot}15 \times 9}{10} = 1{\cdot}935$$ kilogrammètres per second, from which 1·935 × 36,000 = 69,660 kilogrammètres, which makes 22,149 kilogrammètres per kilogramme of active matter (3·145 k. of minium).

B. An accumulator containing 8·100 k. of minium and 8·800 k. of lead was taken.

During	6 h. 30 m.,	a current of	13·33	amp.,	that is	86·64	amp. h.
,, next	9 h. 30 m.	,,	13·	,,	,,	123·50	,,
,, ,,	45 m.	,,	12·	,,	,,	9·	,,
,, ,,	15 m.	,,	11·	,,	,,	2·75	,,
,, ,,	45 m.	,,	10·	,,	,,	7·50	,,
,, ,,	15 m.	,,	9·	,,	,,	2·25	,,
,, ,,	30 m.	,,	8·	,,	,,	4·	,,
	19 h. 10 m.*			Total ...	...	235·64	

Or a current of 13 ampères during nineteen hours.

We have by the following formula :—

$$\text{Tr} = \frac{2{\cdot}15 \times 13}{10} = 2{\cdot}795$$ kilogrammètres per second, from which 2·795 × 68,400 = 191·178 kilogrammètres, or 11,371 kilogrammètres per kilogramme of minium and of lead, or 23,600 kilogrammètres per kilogramme of active matter (8·100 k. of minium).

Such are the figures.

I will add that the measures of the intensity of the current were taken every 15 minutes by the help of a Marcel Deprez galvanometer.

You say that in the preceding calculations no account is taken of the weights of the liquid nor of the holder, and you leave it to be believed that I compare figures thus obtained with those given by other experiments calculated on the total weights of the apparatus, that is, 4,000 kilogrammètres per *kilogramme of the accumulator*. Now I have explained that the results of the experiments of Sir William Thomson show that 5,000 *kilogrammètres per kilogramme of lead and of plumbic matter* can be stored.

This figure of 5,000 kilogrammètres is not an exaggeration, it is even below the truth if you accept the published results of Sir William Thomson in the *Times* of June 9th, 1881. Sir William Thomson states in effect that he had obtained from an accumulator weighing 8·500 k. a quantity of work equal to 260,000 foot pounds, or 35,900 kilogrammètres. I have tried an apparatus of the same pattern and of the same formation, containing 5·700 k. of plumbic matter, that is to say, of lead forming the supporting plates, and the minium; the weight of this last was about 3·500 k. after its transformation into *spongy lead* on one of the plates and peroxyde of lead on the other, this constitutes the *active matter*.

From these figures it results that Sir William Thomson has extracted 6,300 kilogrammètres per kilogramme from the plumbic matter, or 10,250 *kilogrammètres per kilogramme of active matter*, or 4,220 kilogrammètres per kilogramme of dead weight.

This method of giving the results offers the advantage of showing that some progress has resulted other than in the capacity of storage of active matter, in seeking to diminish dead weight.

Sir William Thomson does not give any details of his experiments, which must be accepted with a certain amount of reserve. Up to the present his figures have not been contested; interpreted as I take them they will certainly make those which result from my experiments appear to you less fantastic.

Further still, you make me say that "the discharge operates with a constant electromotive force of 2·15 volts," which is not exactly the case. You add, "The intensity of the current through an unknown resistance at the commencement of the discharge is 13·33 ampères, whilst it is no more than 8 ampères at the conclusion." What is not quite correct is your way of making me say that the electromotive force 2·15 volts is constant. You have made me to say, with as much truth, that the intensity of the current was *constant*, and that the action of the *pesanteur* at Paris is equal to 10. The truth is that I have simply sought to approximate the mean figures, which is not exactly the same thing. It is true, however, that the current varied from 13·33 to 8 ampères; but the duration of the discharge having been 19 hours 10 minutes, and the intensity of the current having taken only 3 hours to fall from 13 to 8 ampères, by neglecting this quantity and keeping 2·15 as the electromotive force for the remainder, the amount of energy stored is still more than 20,300 kilogrammètres per kilogramme of active matter.

In order to measure the electromotive force I had only at my disposal a fine wire Marcel Deprez galvanometer, which was insufficient for exact measurements; I was obliged, therefore, to have recourse to the figures resulting from previous experiments. Now, I read in the same number of the *Annales de l'Electricité*, in the column next to those where are the figures under discussion, that the constant relative electromotive force of the Faure battery is 2·15 volts for the 6·50 k. size. The value is that of M. E. Reynier.

In the number for May, 1881, of *L'Electricien*, page 75, M. Niaudet says that the result of *careful* measurements of the electromotive force of the Faure accumulator shows the value to be 2·25 volts; and he gives figures for evaluating the work in kilogrammètres by the formula—

$$\text{Tr} = \frac{\text{E I}}{\text{g}}$$

M. G. Planté, in his "Recherches sur l'Electricité," page 75, says that when a single secondary Planté couple, well formed, is worked with, the greater part of the numbers found for the electromotive force are between 1·45 and 1·50, the Bunsen being taken as the unit. Now, as the electromotive force of a Bunsen is between 1·89 and 1·96 volts—(Niaudet gives 1·734)—therefore if we take the value of the Planté to be 1·45 of the Bunsen, and the latter to be 1·80 volts, then this gives 2·61 volts as the electromotive force of the Planté (2·51 according to M. Niaudet).

In the same number of the ELECTRICAL REVIEW for 29th

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* Our Correspondent's figures only make 18¼ hours.

July, page 64, there is an article extracted from *Nature*, and entitled "The Chemistry of the Planté and Faure Cell," in which it is stated that the initial electromotive force of a battery freshly charged varies from 2·21 to 2·31 volts, the mean value being taken as 2·25; but after thirty minutes' rest, or of discharge it becomes reduced to 2 volts. This fall is attributed to the liberation of the gas accumulated on the electrodes. In another experiment the electromotive force fell from 2·25 to 1·92 in forty-five minutes, and recovered to 1·96 after thirty minutes' rest, and to 1·98 after eight hours' rest, but the internal resistance was in this case ·58 ohms. Is this resistance that of the whole battery or of a single element? In this last case it is important to know in what condition was the element in question, since the resistance of the accumulator in good condition has been found to vary from ·006 to ·040 ohms during the discharge.

Finally, the experiments of MM. Allard, Le Blanc, Joubert, Potier, and Tresca, have proved a diminution of electromotive force from 2·165 to 2·057 volts, whilst the current falls from 16·37 to 11·49 ampères. In these experiments a sufficient time elapses between the end of the charge and the commencement of the discharge.

In these figures it appears to follow that the constants of the Faure battery are not the same for all the elements, and that they differ according to the state of each. Well, do you not think that it is possible to make these constants much more uniform by regulating the chemical reactions and to increase the storage capacity by facilitating and rendering these reactions more complete?

Why cannot the accumulators be improved as regards the minium? Is it extraordinary to expect to see double the power in the active material in these elements? M. Faure has written somewhere that it is scarcely possible to obtain the tenth part of what the minium can give; there is still, therefore, some margin, and since the accumulator is perfectible, why cannot it be perfected like the steam-engine, for example? The consumption of fuel in the latter has been reduced from 8 or 10 kilogrammes per horse-power per hour down to less than 1 kilogramme. If, now, you wish to be astonished by the reality of the progress already accomplished in the construction of the Faure battery, then, according to ordinary principles, before the application of the active matter on the plates, simply intimately mix with it a very porous and finely divided substance, and you will certainly be less incredulous when you see it work.

I venture to hope that you will not find this letter, foreign to all industrial speculation, too long to be inserted in your next number.

I am, dear Sirs, yours faithfully,

C. BLANCHART.

THE CITY AND GUILDS OF LONDON INSTITUTE TECHNOLOGICAL EXAMINATIONS, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your readers are, no doubt, much indebted to your correspondent, "Fareham," for having, in a recent issue of your paper, brought under their notice the decisions of the examiners in the electrical subjects of these examinations. But while they will also certainly join with him in acknowledging the desirability of having theoretical excellency supported by practical ability, I am confident they will lend no approval to his eminently Quixotic tilt against the scope of the work of this useful organisation. The machinery and work of the City and Guilds of London Institute are subject to the two considerations which rule as regards material appliances, viz., practicability in the first place, and then financial economy. Let "Fareham" give a little careful thought to the matter, as others have done, and he will find that the elaboration and consequent expense required to conduct these examinations on the lines laid down by him would altogether fail to yield a commensurate advantage.

But, after all, it may be that "Fareham" is afflicting himself with needless concern. I may be mistaken, but I understand those only are eligible for examination in any industry who are practically engaged in that special industry. [Mo]reover, the examiner in telegraphy has said in effect (I [quot]e from recollection,) that he had no difficulty in esti[mating] from the papers the extent of the respective students' practical acquaintance with the subject. And in all likelihood the same will hold with the other examiners.

In support of his somewhat vehemently expressed dictum that paper examinations are utterly useless, "Fareham" instances a circumstance, but the inexactness of the narrated details makes impossible the formation of any opinion from them. A is a telegraph testing clerk, we are told; B, a young operator. Five years ago A obtained in magnetism and electricity a "first-class certificate"—whether elementary, or advanced, or honours, "Fareham" leaves to speculating theorists to discover. However, A devotes the greater portion of his time during the five years following to the study of technical telegraphy, and in so doing must, your readers will presume, pay close and enthusiastic regard to the results of invention and research chronicled periodically in the scientific press throughout that period. Yet "Fareham" asserts of this devoted student, who is taken to be typical of practical men, that being so destitute of ability to express himself upon paper, in a recent technological examination in telegraphy, he is signally out-distanced by B, who has attended some class for only six months. The statements in the previous sentence are remarkably strange, in fact, scarcely credible, and since "Fareham" has built his entire argument upon this case, possibly he will not object to make a second and exhaustive inquiry into the facts, and communicate the result to your paper. According to "Fareham," B obtains an honours place, a position understood to be attainable only by those who have at least *some* knowledge of dynamics, chemistry, and mathematics, in addition to a creditable acquaintance with electrical phenomena and laws, and with practical telegraphy.

As regards A's discomfiture, many will in the meantime, like myself, draw the inference that his capacity and his industry are alike microscopic, and that as for the practical testing duties devolving upon him they are likely to be of an exceedingly common and simple order.

A. C. S.

College of Science and Arts,
Glasgow, *August 14th*, 1882.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The suggestion made by your correspondent, "Justice," that "the too easily gulled British public should consult scientific publications instead of financial newspapers when it is asked to subscribe to schemes which embrace the development of scientific inventions," seems to be good common-sense advice, and, for the benefit of the too oft self-deluded public, I send you a few remarks and official statistics in regard to the numerous British patents for telephones and transmitters.

The first British patent for a speaking telephone was that issued to A. G. Bell, No. 4765, December 9, 1876, which, however, was greatly modified by a disclaimer on February 13, 1878.

This patent has undergone critical examination in two courts, viz., at Edinburgh before Lord M'Laren in February last, and at London before Mr. Justice Fry in May last. To those two decisions we are indebted for a clear and concise judicial description of Bell's patent, based upon the evidence given by the most eminent electricians in Great Britain. This decision is of the highest importance to investors in telephone property, whether it be in telephone companies or in telephone patents, because it is so clear and simple that any one possessed of common sense can judge for himself as to what constitutes Bell's patent and what constitutes an infringement of Bell's patent.

Bell's original patent contained eighteen claims, the disclaimer reduced them to eight; of these, the 6th, 7th, and 8th, contain the soul of the patent, which is the same in those three claims.

The 6th claim is, "The combination in the manner described in the fourth and fifth plans, but subject always to the disclaiming notes, of an electro-magnet, with a plate of iron or steel or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet."

In the suit of the United Telephone Company against Harrison, Cox-Walker, the latter set up for defence the prior publication of a description of Reis's instrument of 1862. In the Reis instrument there was, "facing the poles of the electro-magnet, an armature attached to a broad, thin, but light plate."

As Bell's claim was for a plate of any material capable of inductive action in combination with an electro-magnet, the eminent counsel for the United Telephone Company (Mr. Aston, Q.C.,) said, "The whole case turned on the question of whether or not there was a publication of a receiver having a plate armature prior to December, 1876." He contended that the broad, thin, light plate of Reis, which counsel called a "bar" or "tongue," "was in no sense a plate armature; and as the plate armature was essential in Bell, and the 'bar' used in Reis was in no sense a plate armature, and therefore no anticipation of Bell's."

The plate armature in Bell's is described by Sir William Thomson as an iron or steel disc fixed all around its edges. Mr. Aston insisted "particularly in the fundamental distinction between the 'bar' in Reis and the plate armature in the Bell."

Mr. Justice Fry describes the plate armature of Bell as "a metal disc resting, as regards its circumference, on the wooden case;" and he further says that "the armature in Reis was not a disc at all, it was not a plate at all, but it was a beam or solid bar;" and he decided that the "Reis receiver was not in anticipation of Bell's receiver."

It is, then, clearly established that in a telephone receiver the use of a disc of a material capable of inductive action fixed all around its edges is secured to Bell; and it is further established that a "tongue" or "bar," as in the Reis instrument, is outside of Bell's patent.

I submit two complete lists of British patents for telephone receivers. The first contains those patents in which a disc capable of inductive action is used in combination with a magnet or electro-magnet. The second list contains those in which there is not used a disc capable of inductive action. Let inventors judge for themselves.

List of British patents for telephone receivers in which a disc capable of inductive action is used in combination with a magnet:—

No.	Date.	Inventor.	Remarks.
		1876.	
4,765	December 9th	A. G. Bell	
	February 13th, 1878	A. G. Bell ..	.. Disclaimer
		1877.	
2,909	July 30th	T. A. Edison	
	February 10th, 1880	T. A. Edison	.. 1st Disclaimer, disc abandoned
	June 13th, 1881 ..	T. A. Edison	.. 2nd Disclaimer
	November 29th, 1882	T. A. Edison	.. 3rd Disclaimer
4,685	December 10th ..	Siemens	
4,847	December 20th ..	C. A. M'Evoy	
4,934	December 29th ..	C. W. Harrison	
		1878.	
611	February 14th.. ..	A. G. Bell	
617	February 14th.. ..	G. B. Richmond	
1,779	May 2nd	G. M. Phelps	
1,882	May 10th	E. Gray	
1,917	May 23rd	G. S. Hickley	
2,396	June 15th..	T. A. Edison	
2,527	June 25th..	Dr. W. Siemens	
3,892	October 3rd	Gower & Roosevelt	
3,960	October 8th	L. V. Mandroux	
4,210	October 22nd	G. M. Phelps	
		1879.	
315	January 25th	Gower & Roosevelt	
394	January 30th	Gower & Roosevelt	
1,476	April 16th	A. B. Roxburgh	

Telephones without a disc capable of inductive action:—

No.	Date.	Inventor.	Remarks.
2,262	June 1st, 1878 ..	W. H. Preece	
3,004	September 27th, 1878	E. Gray	

If the above be acceptable I shall continue the report of patents of telephone receivers for 1880-81, and for transmitters from Bell's of 1876.

Yours, &c.,

COMMON SENSE.

[We shall be glad to publish the further communication promised by our correspondent.—EDS. ELEC. REV.]

THE ELECTRIC LIGHTING BILL.

HOUSE OF COMMONS, Monday, *August 14th.*

ON the motion to consider the House of Lords' amendments to the Electric Lighting Bill,

Sir John Jenkins protested against the amendment extending from 15 to 21 years the duration of a licence before a local authority could compulsorily acquire an installation without compensation for retrospective or prospective profits.

Mr. Dillwyn thought 21 years a very long period, and hoped the President of the Board of Trade would adhere to the compromise he had introduced into the Bill.

Mr. Chamberlain said the hon. member for Swansea was correct in his statement of the circumstances under which the compromise of 15 years was arrived at. When he recommended 15 years to the Select Committee, and when the question was last discussed in the House, he was of opinion that that compromise was a fair one, but since then further information had been put before him which had made a difference in his opinion, and which he thought might perhaps also alter the opinion of his hon. friend. When the matter was discussed before the select committee it was certainly believed by that committee that in the present experimental stage of electric lighting there would be no great expenditure of capital, and that if it was intended to make an experiment by lighting a few houses, a street, or some small district, a monopoly of 15 years would be quite sufficient to remunerate the promoters for their outlay. But already, in the short time during which the matter had been under consideration, very great advancement had been made in electric lighting, and now it seemed probable that large instalments would in some cases be made, involving an outlay of hundreds of thousands of pounds, and it did not seem to him that 14 or 15 years would in all cases be long enough to justify a great outlay of capital. If companies were restricted to the shorter period they would not be inclined to invest their capital, and so that development would not be given to electric lighting which was so desirable. For these reasons he had been willing to reconsider his first opinion. An amendment had been proposed in the other House suggesting that the period during which companies should be empowered to supply electric light before being subject to be bought up under the purchase clause should be extended to 21 years. He had objected to that because it would involve the granting of 21 years in the case of small installations as well as large ones, and so he had secured an amendment to that amendment; and in the Bill now came before them the period was a maximum of 21 years, giving the local authorities, in all cases where applications were made to them for permission to experiment, the power of coming to an agreement with the applicants whereby a shorter term might be consented to. Under these circumstances he hoped no grievance would result; and he believed the clause would be found to work satisfactorily, and at the same time prevent a monopoly being set up which would be dangerous to public interests.

Sir John Lubbock said the power which the local authorities would have of purchasing an installation was a very different thing from a monopoly. When the term had been fixed at 15 years, the chairmen of the Edison and the Swan companies protested against it, saying they were not satisfied. He agreed with the right hon. gentleman, that in a case where a quarter or half a million of money came to be invested, and the company was liable to be bought up in 15 years, the term was too short and should be extended. No doubt the hon. member for Swansea was right in saying that the electric lighting was still in an experimental stage, but the fact that it could be carried on successfully and generally had been established by the experience attained at Holborn Viaduct and other places; and the only question now to be decided was, Which was the best system? He hoped the House would agree to the amendment.

The amendments suggested by the House of Lords were then agreed to. Among them were the following:—

In p. 2, l. 29, after "given," insert as a new sub-section:—"A licence may, subject to the provisions of this Act, be granted to a local authority, authorising them to supply electricity within any area, although the same, or some part thereof, may not be included within their own district."

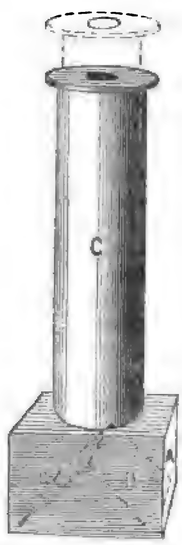
In p. 3, l. 17, after "provisions," insert as a new sub-section:—"No provisional order shall authorise the supply of any electricity by any undertakers within the district of any local authority (not being themselves the undertakers) unless notice that such provisional order has been, or is intended to be, applied for has been given to such local authority, in such manner as the Board of Trade may direct or approve, on or before the 1st day of July in the year in which such application is made; provided that, in the case of any application made during the present year, such notice shall be deemed to have been given in due time if the same is given within one month after the passing of this Act."

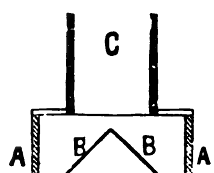
ELECTRIC LIGHT IN THE EDGWARE ROAD.—An installation of 50 incandescent lamps on the Swan system has just been completed for lighting the premises of Mr. Bouron, provision merchant, at 279, Edgware Road. The lights, which are in use every evening, are a great success and are worked by a small gas-engine on the premises. A great saving is expected in the quantity of provisions usually spoiled owing to the absence of heat in using these lights, the shop therefore being kept cool. The work has been carried out by Messrs. Edmundson & Co., of 19, Great George Street, Westminster, agents for the Swan system, who are engaged also in some much larger installations.

NOTES.

Errata.—In the article on the lighting of the Comptoir d'Escompte in our last issue, for "Corrozer" read "Corroyer"; for "each cubic metre" of solution read "for two cubic metres"; and for "ten carbons of ten millimetres" read "with carbons of ten millimetres."

A Pocket Photometer.—This little instrument, which will doubtless be of service to all who are engaged in electric or other kinds of lighting, has been devised by Mr. Robert Sabine for the purpose of being conveniently carried about in the pocket, so as to be at all times accessible for approximately measuring the respective illuminating power of different lights. Its construction is based on the plan proposed by Ritchie, which we illustrated and described in an article on Photometers in the Electrical Review of April 8th. In the rectangular base of this little instrument—the





two ends of which are closed by squares of opal glass, A, A, cut from the same sheet—is a prism, B, B, made up of two plane mirrors fixed at right angles. The draw-tube containing the eye piece, in which is inserted a small lens, is movable in the outside tube, C, attached to the base, and a correct focus may therefore be obtained and the mirrors clearly seen from a very short distance,—about 4 inches. Were it not for the introduction of this lens, the tube down which the observer looks would have to be considerably longer in order to obtain a clear view of the plane mirrors. As the operation of using distance photometers is so well known, it is needless to refer to it. Any one could construct such an instrument for his own use at the expense of 2s. 6d. or 3s. The sketch sufficiently explains all the details of its construction. We may add that we believe Messrs. Elliott Bros., the well-known electrical instrument makers, will shortly be able to supply these little photometers to those desirous of becoming possessed of such a useful and handy means of measuring any kind of light.

The Bewildering Higgs.—In our brief notice of this matter last week we omitted to state that which is, however, already well known in electrical circles, viz., that the legal action taken by Messrs. Siemens Brothers against the subject of our note was dismissed. The *New York Times* of June 16th, after devoting some space to the attainments of Dr. Paget Higgs, says:

He came here under the auspices of S. F. Van Choate, of Boston, Mass., to do some work for the American Cable Company of that city, which required the highest mathematical and electrical knowledge. He was very highly recommended (?) by Siemens the famous English electrician, and the work he was engaged to do was performed in a satisfactory manner. . . . . In the intervals between his work for the cable people he unfolded, slowly and cleverly, the details of a wonderful contrivance he had invented for the transmission of power by electricity, which was stated to be in successful operation in Wales. . . . . . A fortune seemed to be within his grasp, and yet he did not seem anxious to reach out and take it. Mr. Van Choate was fascinated with the brilliant future that seemed to be open to any one who could induce Higgs to remain on this side of the Atlantic and develop his plans here. He forgot in his enthusiasm what he well knew, that Higgs' coming to this country was under suspicious circumstances. . . . A company was organised in Boston through the efforts of Mr. Van Choate and Russell A. Ballou. The capital, on paper, was 5,000,000 dols.; the object, to develop Mr. Higgs' plan for an economic electric light, for the electrical transmission of power, and the construction of storage batteries. Mr. Higgs began the development of his theories and ideas, made applications for patents, and frequently reported progress in the most glowing terms. He is said to have received 10,000 dols. for his alleged services in that city. A date was finally fixed for the exhibition of one of his inventions, and the promise was made that if his machine for the transmission of power was successful he should receive 50,000 dols. in cash, and 1,300,000 dols. in stock of the proposed company for his patents and services. He made over all his applications for patents, and, after the manner of Keely, boasted of the probabilities and possibilities of his inventions. The day before the date fixed for the exhibition, Dr. Paget Higgs left Boston, leaving behind him a message that he had left the city because of his father's sudden death. Then he came to New York City, and those Bostonians who invested in his promises have not seen him since, though at intervals he wrote to his friends there informing them of the progress he was making. They trusted him, and so far as can be ascertained sunk more money in the doctor's abysmal pocket. When Dr. Paget Higgs came to New York City he established himself on the parlour floor of a house on Twenty-third Street, facing Madison Square, and threw out his lines for a new lot of fish, so to speak. . . . A company, known as the Higgs Electric Light and Power Company was organised, but as a quarrel ensued between Mr. Higgs and the other projectors of the company, which was to have a capital of 500,000 dols., Mr. Higgs refused to go ahead and perfect his inventions; the company found no further reason for their existence on paper, and went out of business without having done any business. . . . . The inadaptibility of Dr. Higgs to manage the business of the proposed company was known, and one of the gentlemen interested in the doctor and his plans induced a friend, Frederick W. Harne, then superintendent of a slate quarry at Bangor, Penn., to accept the business management of the proposed new company. . . . . He went to Chicago to prepare the way for the organisation and work of the new company. After some trouble he succeeded in securing a plant for the proposed electric light in the Tremont House in that city, and made a contract to light the hotel with Higgs' light. Dr. Higgs was established in a laboratory at No. 63, Kent Street, Greenpoint, Long Island, and began work on the development of his electric light. . . . . All this was about the 1st of January last. About that time, or just before it, he had sold and shipped two electric lights to Montreal, Canada, neither of which would work, a fact not known until comparatively recently, however. About the middle of January he exhibited at Greenpoint, to Mr. Harne and others, a light which he claimed as his own, but which, it has been since proved, was a Wood's lamp run by a Wood's dynamo-machine. . . . . But to return to the Chicago enterprise. Mr. Harne went to that city, established his plant, bought his engines, and on the 15th of February, having paid to Dr. Higgs 700 dols. for dynamo-machines, lamps, &c., after a delay of a week a couple of dynamo-machines arrived in Chicago; but, as Mr. Harne was a novice in the electric lighting business, he did not discover the fact that they were of the Wood make. . . . The complete failure of the scheme induced Mr. Harne to make an investigation into Higgs' antecedents, and he accidentally heard of Mr. Van Choate, in Boston, as having a knowledge of Higgs and his antecedents. In response to a letter of inquiry Mr. Van Choate wrote from Boston, under date of April 2nd, as follows:—

"I imported him into this country a little over two years ago, and for which I am very sorry. . . . . So far as my dealings with him go, I have found him to be the greatest liar, scamp, and fraud of all the men I ever heard of during my thirty years' business with people. He has no capability for inventing anything but lies." . . . . Higgs shipped his wife to England on an Inman steamer as soon as the disclosures of his true character seemed imminent, and he followed her on the *Alaska*, which left this port on May 31st. The various investors were badly left, and the mystery of his inventions departed with him. . . . . The case of Dr. Higgs is a very peculiar one, there seeming to be wholly unnecessary prostitution of undoubted talents. Why this was done does not wholly appear, for he does not seem to have obtained money from his dupes for his personal benefit, and such money as he did obtain was expended in the prosecution of electrical experiments. . . . . It has recently been ascertained that for some unprofessional practices Dr. Higgs was expelled from the Institute of Civil Engineers in England. During his stay here it has been ascertained that the only storage battery that he invented was the previously invented Sellon and Volckmar storage battery; the only dynamo-machine that has worked, the Wood machine; and the only electric lamp, one that will not burn in series and is not a remarkable success as a single light. So far as can be ascertained, the money he has been able to [illegible] from Americans will not aggregate more than 20,000 dols., unless [illegible] losses of the Philadelphians are larger than the 5,000 dols. at which they are estimated. That amount also represents the sum he obtaine[illegible] in this city.

The Central Laboratory of Electricity in Pari[illegible] —The French Minister of Posts and Telegraphs has a[illegible] pointed a special commission to study the organisation [illegible] the working of the Central Laboratory of Electricity. [illegible] commission is composed of the following gentlemen:—

Songeon, president du conseil municipal de Paris; D[illegible] member de l'Institut, secrétaire perpétuel de l'Acadé[illegible] Sciences; Alphand, directeur des travaux de Paris [illegible] member de l'Institut; Le Colonel Perrier, m[illegible]

l'Institut et du Bureau des Longitudes; Bréguet, membre de l'Institut et du Bureau des Longitudes; Tisserand, conseiller d'Etat, directeur au Ministère de l'Agriculture; Mascart, professor au Collège de France, directeur du Bureau Central Météorologique; Becquerel, ingénieur ordinaire des ponts et chaussées, répétiteur de physique à l'Ecole Polytechnique; Fournier, capitaine de frégate, attaché à l'état-major du Ministère de la Marine et des Colonies; Penel, commandant du génie, attaché à l'état-major général du Ministre de la Guerre; Mercadier, ingénieur-electricien, directeur des études à l'Ecole Polytechnique; Bergon, directeur du matériel et de la construction au Ministère des Postes et des Télégraphes; Blavier, directeur de l'Ecole Supérieure de Télégraphie au Ministère des Postes et des Télégraphes; Boussac, inspecteur-général chargé des services du contrôle au Ministère des Postes et des Télégraphes; Caël, directeur-ingénieur des Télégraphes; Georges Cochéry, directeur du cabinet et du service général au Ministère des Postes et des Télégraphes; Fribourg, directeur du personnel au Ministère des Postes et des Télégraphes; Raynaud, ingénieur des Télégraphes; Trotin, ingénieur des Télégraphes.

Tenders for the Supply of Telegraph Material.—We read in the *Moniteur des Adjudications de l'Etat*, that the French Telegraph Administration invites tenders for the supply of the following instruments, stores, &c., the adjudication of which will take place on the 22nd inst., viz.:—

1. The supply of sending and receiving telegraph instruments divided in 16 lots, composed of 60 Hughes' instruments, 1,800 Morse receivers, 8 transmitters, 8 receivers, and 80 Wheatstone perforators, 1,400 sounders, 1,500 electric bells, 2,200 detectors.

2. The supply of additional apparatus for telegraph offices, divided in 10 lots, and composed of 1,700 Morse keys, 3,700 commutators, 800 bell pushes, 4,400 lightning protectors of various systems, 1,200 paper-wheels, 15,000 brass-screw terminal, 25,000 brass strips for table connections, 6,000 battery terminals, 10,000 ebonite case pieces (socles), 20,000 ebonite washers, and 400 oak boxes.

3. The supply of materials and chemical productions for batteries, divided in nine lots, and composed of 46,000 glass jars of various models, 60,000 porous pots, 172,000 various zinc pieces for batteries, 10,000 kilogs. of bi-oxide of manganese, 10,000 kilogs. of chlorhydrate of ammoniac, 90,000 kilogs. of sulphate of copper, 8,000 kilogs. of pounded retort carbon, 4,000 kilogs. of dextrine, 70,000 prisms of retort carbon, and 3,000 kilogs. of copper wire of ·08 diameter.

Further particulars may be obtained from the Administration, 103, Rue de Grenelle, Saint Germain, Paris.

The Maxim Incandescent Electric Lamp.—We believe that this light has been withdrawn from the General Post-office at Glasgow, amid universal grumbling on the part of the men. We hear various rumours to account for this, and from what we can understand the matter is apparently a personal one. The blame however will doubtless be cast upon the electric light in some form or other.

The Electric Lighting of Theatres at Paris.—After the recent experiments of electric lighting made at the Théâtre des Variétés, M. Bertrand has determined to light his house for a whole season, from September, 1882, until June, 1883, by incandescent lamps. After this long trial, electric lighting will be used permanently or discontinued. The other directors of the theatre await the results of this innovation before making a decision. Meanwhile, the manager of the Eden Theatre, at present in course of construction, has determined to adopt electricity for the complete illumination of the theatre, making use of the voltaic arc and incandescence, by means of Maxim lamps and Kabath accumulators, charged from the necessary apparatus placed in the basement of the Eden. The experiments in preparation are, therefore, very interesting, and we will follow their development carefully.

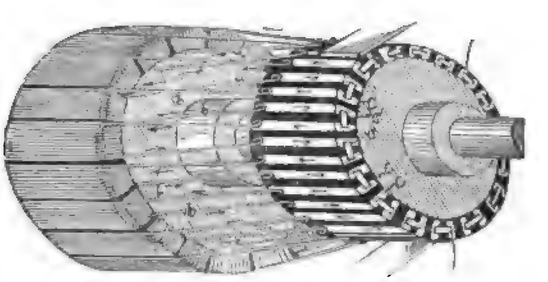
The Electric Light at Liverpool.—We hear that the Edison electric light, to which we alluded last week, has been used with great success at the Adelphi Hotel. Three large burners in the great ball-room, and another in the hall, have shed a brilliant radiance on the illustrious guests who have been in the city recently in connection with the International Law Conference.

The Brush Midland Electric Light and Power Company, Limited.—This Company has received an order to light up the factory of Messrs. Birkin Brothers, the well-known lace manufacturers of Nottingham, with Brush arc and Lane-Fox incandescent lamps.

At Gainsborough the same company, in compliance with the request of a number of the leading inhabitants of that town, who undertook to defray all expenses, has during the past fortnight very successfully illuminated the market-place with Brush arc lamps, and also exhibited Lane-Fox incandescent lamps in the shop of one of the principal tradesmen. Both the arc and incandescent lamps were run on a single circuit from the same machine, and were proved to be under perfect control. Numerous applications for electric lights—especially for the Lane-Fox lamps—have, we understand, been received by the company.

The Cost of the Electric Light at Edinburgh.—The abstract of the Edinburgh Police accounts, just issued, shows that for the "experimental electric lighting" of the North Bridge, Waverley Bridge, and Princes Street, on the "Brush" system, from the 25th August, 1881, to the 2nd January, 1882, the city paid the sum of £1,181 4s. 8d.; and for a trial of the "Crompton" at Holyrood Palace, August 25th, to September 8th, £57 13s. 7d. Expenses of deputations to London bring up the total cost to £1,265 1s. 3d. The sum of these experiments is made up as follows:—Fitting up engine-house, electrical machines, &c., £115 0s. 6d.; Furnishings to engine-house, machinery, coals, and firewood, £170 15s. 9d.; Wages of watchman, and attendants at machines and lamps, £39 16s. 3d.; Lamp pillars and bases (pillars, £209; stone bases, £62 8s.; mason work at lamps, £10 6s. 8d.), £281 14s. 8d.; Electric lighting (the Anglo-American Brush Electric Light Corporation, Limited, 25th August, to 30th November, 1881, £389 10s.; the Scottish Brush Electric Light and Power Company, Limited, 3rd December, 1881, to 2nd January, 1882, £184 7s. 6d), £573 17s. 6d. Total, £1,181 4s. 8d. At Holyrood: Fitting up lamp poles, £17 13s. 7d.; The Crompton Electric Lighting Company, for electric lighting, 25th August to 8th September, 1881, £40. Total, £57 13. 7d. General Expenses: Expenses of deputations to London on experimental electric lighting, May and June, 1881, £26 3s. Total cost, £1,265 1s. 3d.

Commutator for Dynamo-Electric Machines.—Patent No. 261,520. Filed in the United States of America Patent Office, February 15th, 1882.—By R. Edward Ball.



Claim.—1. An armature for dynamo-electric machines, having each end of every bobbin thereof connected to a separate block in the commutator ring and such blocks coupled together in pairs, so that a current generated in one of said bobbins must pass to and through a pair of commutator-blocks before passing to a succeeding bobbin, substantially as shown and described.

2. In combination with an armature of a dynamo-electric machine, a commutator therefor having twice as many blocks as there are bobbins or sections on the armature-ring, so as to provide for each end of every such section being connected to a separate commutator-block, such blocks being coupled in pairs, substantially as shown and described.

3. An armature for dynamo-electric machines, the bobbins or sections whereof are disconnected from each other, each end of every bobbin being connected to a separate block in the commutator, such blocks being coupled together in pairs, and thereby forming an indirect connection for said bobbins, substantially as shown and described.

THE EDISON LIGHT IN ITALY.—We have received notice that Mr. Shepherd, the agent of the Edison Company in Italy, has succeeded in forming a syndicate of the principal bankers in Milan for the purpose of working the Edison patents in Italy. Mr. Shepherd remains with them as agent-general. This gentleman has just been lighting up a portion of Udine with the Edison light, which has proved such a success that he is preparing a contract for lighting the whole of the city. The motive force will be supplied by the River Ledra. The cities of Mortara, Pistoja, Faenza, Fano, Arezzo, Schio, and several others are also to be lighted by this system, and in Milan the theatre Santa Radegonda has been purchased for a lighting station, and part of La Scala theatre will be illuminated during the Carnival from it, and the principal shopkeepers have ordered their shops to be lighted—one firm alone having ordered 1,200 lamps.

THE COST OF THE ELECTRIC LIGHT.—We notice that Lieutenant-Colonel Festing reports that the substitution of electric lighting, by the aid of two machines driven by one engine, in the place of gas, at the South Kensington Museum, has resulted in a saving in the working expenses at the rate of nearly £750 a year, or more than £23 per annum for each lamp.

COPYRIGHT AND ELECTRIC LIGHT COMPANIES.—A motion was made in the action of "The London and Provincial Electric Lighting and Power Generating Company (Limited) *v.* The West Middlesex Electric Lighting Company (Limited)," to restrain the publication of a prospectus which the plaintiffs alleged was a copy of one which they had issued, and in which they had copyright rights. Mr. Ribton, for the plaintiffs, said since the matter was last before Mr. Justice Chitty the defendants had filed an affidavit stating that they had discontinued the issue of the prospectus in question, and had no intention of reissuing it. Under these circumstances, he asked that the motion should stand over until the second motion day in November. Mr. Marten, Q.C., acquiesced in the suggestion, and the motion, without prejudice, stands over accordingly.

THE SCOTTISH BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED) IN LIQUIDATION.—Intimation is given that all claims against this company must be lodged, duly vouched, with Mr. Jas. A. Molleson, 5, North St. David Street, Edinburgh, on or before Wednesday, the 23rd inst.

TELEGRAM FORMS.—F. H., in a letter to the *Times*, suggests that telegram forms should be supplied with a gummed flap, so that they might be folded and delivered sealed at the office for transmission, thereby doing away with the disadvantage of submitting the message to the perusal of the messenger.

THE NEW CABLE TO PORT SAID.—On Friday last Mr. John Pender, M.P., received a telegram from the Eastern Telegraph Company's agent announcing the completion of the new telegraph line to Port Said. The promptitude with which the work has been carried out reflects great credit on all concerned.

CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY.—The India-rubber, Gutta-percha and Telegraph Works Company notify the receipt of a telegram from Mr. R. K. Gray, engineer-in-chief, stating that the ss. *Silvertown* had successfully completed, on the 10th inst., the San Juan del Sur-Pedro Gonzales section of the Central and South American Telegraph Company's cables.

This section was the last one to be laid, and the company's system on the West Coast of Central and South America, from Chorillos (Peru) to Salina Cruz, Tehuantepec (Mexico), is therefore now completed. On the Atlantic side the Goatzacoalcos-Vera-Cruz section connects this company's system with the Mexican Telegraph Company's cables from Vera-Cruz to Galveston, and an excellent communication is now established between the republics of Chili, Peru, Ecuador, U.S. of Columbia, Nicaragua, San Salvador, and Mexico, and the U.S. of North America. We notice in the Panama *Star and Herald* of June 22nd the following interesting items relative to the operations of the above-named company :—

"The cable steamer *Retriever* has been occupied the past two days in laying the shore end of the cable which is to place us, at an early date, in communication with the outside world. The place at which the cable was landed is about a couple of hundred yards to the eastward of the point where the road leading past the cemetery comes out on the beach. From deep water it is laid entirely in a mud or sand bottom to where it is now located. Great care was exercised in selecting the place, so that no rough or jagged rocks would be met with which would chafe or injure the cable in any way. In order to make connection with the cable now buoyed off Pacheco, one of the Pearl Islands, the *Retriever* will continue the work, laying the cable inside of Taboga and other islands, and on bottom not likely to be disturbed by vessels coming to an anchor in the port or at Taboga. The connection at Pacheco will probably be made to-day or to-morrow, when the *Retriever* will return to Taboga.

"Yesterday the connection was made between the shore section of the cable at Panama and the line buoyed off the island of Pedro Gonzales, one of the Pearl Island group. The *Silvertown* picked up the buoy behind Taboga, to which the cable was attached, and got under weigh about eight o'clock, completing the run down to the Pearl Islands and splicing the cable in a few hours from the time of starting. From the station on shore signals were exchanged with the *Silvertown* at the Pearl Islands, and to-day the line thus completed will be tested through to Lima.

"In response to the courteous invitation of Mr. J. B. Poylo a number of our principal townspeople visited the cable ships *Silvertown* and *Retriever* on Sunday, the 18th inst. The steamer *Taboguilla* took the invited guests on board in the morning, sailing about eight o'clock, calling at the island for some other guests, and arrived alongside the *Silvertown* about eleven o'clock. The two ships were lying side by side, and were gaily decorated for the occasion. A sumptuous lunch was served on board, after which dancing was indulged in until the hour for return was notified. The band of the 1st Battalion of Zapadores furnished the music for the occasion, through the kindness of General Capella Toledo, who was among the visitors. The excursion was in every respect a great success, and the ladies and gentlemen enjoying it express unqualified praise of the kindness and courtesy of the officers of the two cable ships and the other gentlemen connected with the expedition.

"The Cable ships *Retriever* and *Silvertown* will sail to-day for the Coast of Central America. They will leave the line connected as far as Panama, where it will be completed to the station in a few days and tested for any defects which may exist between here and Buenaventura. The two ships will call at San Juan del Sur in Nicaragua, and at La Libertad in Salvador, or San José de Guatemala, laying the shore sections, if the weather is good. Proceeding thence to Salinas Cruz the line will be landed and then run down along the coast, making connections with the various shore sections until the island of Pedro Gonzales is reached, where the last splice will be made and the work completed. The T. line to Panama is shorter than was originally intended. It was discovered that the depth of water across the entrance to the bay was much greater than was supposed, being in some places over 2,000 fathoms. The bottom shelves off very abruptly in places a short distance below the Pearl Islands. Lines of soundings made across the bay present some remarkable differences in depth, in some instances soundings a mile apart giving a difference of 1,000 fathoms. Soundings about 8 miles South of the Pearl Islands and North of Cape Malo gave as much as 1,800 fathoms of water, while a little further South a depth of 2,004 fathoms was reached. As the contract provided that the cable should be laid in water not over 400 fathoms deep, the original course has been abandoned, and the line of the coast has been followed, keeping to a uniform depth of water. This plan, it is believed will make the work of repairs in the future a matter of much less difficulty than if the cable had been laid in very deep water. The bottom discovered along the coast presents the same general features, and is principally a dark greenish coloured mud, in which the cable will rest with perfect safety. A vast number of specimens of this muddy deposit have been secured and chemically tested, showing, we believe, few or no traces of copper, iron pyrites, or other mineral agents whose effects on the steel sheathings of the cables are most destructive."

SUBMARINE TELEPHONE EXPERIMENTS.—Recently experiments have been conducted at Havre with a view of establishing telephonic communication between vessels and the shore. From the reports which have reached us it would appear that the operations have been attended with a large measure of success. In spite of rough weather the cable was successfully laid, and various persons and offices in the town were put in connection with the vessel anchored at nearly a mile distant from the premises of the Marie Christine Club. The Ader and Crossley instruments were used, and conversation was very distinctly maintained, notwithstanding the heavy gale, which caused the vessel to roll considerably.

This new application of the telephone will render important service to maritime commerce, since it will allow vessels arriving at a port to place themselves immediately in direct communication with owners or agents ashore. As a result of the successful experiment above referred to, a proposal to form a pontoon structure, to be moored at a distance from the land, on board of which public telephones should be placed for use by ships has already been mooted at Havre.

THE UNITED TELEPHONE COMPANY.—This company is now becoming most energetic. A circular has been sent to its various subscribers couched in these terms :—

SIR,—Will you kindly furnish us with the names of any firms, friends of yours, who are not connected with our Telephone Exchange system, so that we may put ourselves in communication with them, with a view to extend our system, in order that it may be of greater service to yourselves and to our subscribers generally ?

Your obedient servant,,

THOMAS BLAIKIE, Secretary.

The self-sacrificing motive of the company in its consideration for its present subscribers will no doubt be duly appreciated.

THE SUEZ CANAL AND TELEGRAPHIC EXTENSION.—A Lloyd's telegram from Port Said dated August 15th, 2.15 p.m., states that the Suez Canal continues free. M. de Lesseps is reported to be impeding the extension of the new telegraph system from Port Said to Suez. The laying of that portion of the line, which would form a valuable connection with our Indian system, is, therefore, for the present suspended. The Eastern Telegraph Company have permission from the Khedive and the Suez Canal Company at Paris to lay the lines ; but this is ineffectual against the obstacles put in the way of the work at the Canal by M. de Lesseps.

THE GOVERNMENT AND THE TELEPHONE.—In a letter to the *Times*, dated the 14th inst. and signed "Electrician," the writer, in referring to Mr. Fawcett's statement in Parliament, says :—

The public could scarcely imagine from this statement that the Post-office taxes the telephone companies to the extent of at least £2 for each subscriber to central office systems. This is equal in London on 2,000 subscribers to £4,000 per annum. How, in face of this fact, Mr. Fawcett can talk of free competition between the companies and the Government is simply inconceivable.

Again, under the Post-office Acts, the Government can fix their poles or wires in or on any person's premises (even in your front garden, if they like), and all the aggrieved owner can do is to claim compensation at the hands of an arbitrator. As a matter of fact, from being Governmental, the Post-office gets most of its permissions for practically nothing.

The telephone companies on the other hand, have no such powers, but must negotiate for each permit, and pay whatever is demanded, and often very extravagant the demands are. Tenants, as well as proprietors, have frequently to be settled with likewise.

Unless, therefore, the Government are prepared to surrender their tax and to give the companies the same statutory powers it is a farce to talk of free competition with the Post-office.

THE STORM ON THE 13TH OF AUGUST AT PARIS.—A violent storm broke over Paris last Sunday at four o'clock in the morning, where it has done considerable damage. In the garden of l'Elysée, the residence of the President of the Republic, the lightning has struck a tree and stripped off the bark from top to bottom. In front of the Hôtel Dieu it struck the lamp of a carriage, and reduced it to atoms without the coachman and a passenger who occupied the vehicle feeling anything. We may add to these depredations the destruction of the roof of a house and the burning down of a cart-shed. Six women occupied in a washhouse were knocked down by the storm without any injury, but in the Boulevard de Belleville a woman was dangerously burnt on the face, and was conveyed to the Hospital of Saint Louis in an alarming condition.

TELEGRAPHS IN TURKEY.—The Turkish Government has issued a new tariff for telegraph messages. According to an imperial irade, given on the proposal of the General Administration of Posts and Telegraphs, and on the advice of the State Counsel, confirmed by the Counsel of Ministers, the internal telegraph service will henceforth be managed according to the rules of the Telegraph Convention of St. Petersburg and as revised at the conference in London.

One of the principal rules of this regulation is the taxation per word, with an *appoint* of five words, which forms the price, properly called, of the telegram. The charge per word is fixed for the whole of Turkey at 20 paras for telegrams exchanged between telegraph stations situated in any one and the same province, and at 40 paras for telegrams forwarded from one province to another, either near or far off.

This new tariff realises an exceptionally favourable condition for the development of the telegraph service in Turkey.—*La Lumière Electrique.*

ON THE VARIATION OF FRICTION PRODUCED BY VOLTAIC POLARISATION.—By M. Krouchkoll.—The electromotograph of Edison has drawn the attention of physicists to a novel fact, that of the variation of friction between a metallic surface and an electrolyte when a current is passed between the two rubbing surfaces. M. Koch published in 1879 an Investigation (*Wiedemann's Annalen* 1879, p. 92), in which he shows that polarisation by oxygen alters the rubbing surface of the platinum or palladium in such a manner as to increase the friction. Polarisation by hydrogen produces, according to this author, no effect. I have resumed these experiments under different conditions and have shown that polarisation by oxygen increases the friction, whilst polarisation by hydrogen decreases it. The electromotive force of half a Daniell is sufficient to demonstrate the phenomena. The decrease of friction by negative polarisation and its augmentation by positive polarisation increase with the electromotive force displayed.—*Comptes Rendus.*

ON THE AMPLITUDE OF TELEPHONIC VIBRATIONS.—By M. G. Salet.—Every one knows that it is possible to hear through a fir-wood door of little thickness words spoken in a room otherwise entirely closed. In this case, the sonorous vibrations transmitted by the air shake synchronously the side of the wood, and this in turn transmits its motion to the external air just as a movable piston might do. This familiar experiment ought, it may seem, to have struck physicists, since it gives a proof of the sensibility of the ear. The vibrations of the wood are, indeed, very small, scarcely larger than those of the receiving membrane of a telephone when in action, but these latter are so slight that their very existence has sometimes been called in question. They exist, however, and I am about to give an idea of their amplitude. I fixed upon the iron diaphragm of a hand-telephone of Bell's system a small disc of glass, weighing 0·45 gram. Opposite this I fixed a second, yielding with the former, Newton's rings. The apparatus, as will be seen, resembles that which M. Fizeau devised for studying expansions. If we speak at the distance of five to six metres from the telephone, or if we direct against it a telephonic current produced by means of a good transmitter (that of Boettscher, for instance, which does not require the use of a battery), we see the rings lose their distinctness and disappear if the voice is raised a little. They vibrate, in fact, themselves, synchronously with the iron diaphragm, and nothing is more simple than to calculate the amplitude of the vibrations of the diaphragm from that of their oscillations.

It is certain that the additional weight of 0·45 grams placed upon the diaphragm, must render its movements somewhat less extensive ; hence the results obtained fail rather on the side of deficiency than of excess.

To value the displacement of the rings, we arrange before the telephonic receiver, into which a continuous sound is emitted, a turning disc pierced with slits. It

is found that at a certain speed of rotation the rings reappear distinctly. If we then blow across the disc, making it act a siren, we find that the sound produced is in unison with that transmitted by the telephone. If it lowers or rises slightly, the rings oscillate, at first slowly and then with such a rapidity that they again become invisible. Whilst they oscillate, this displacement may be easily estimated. In an experiment made, the amplitude of the vibrations of the receiving plate was from two to three ten-thousandths of a millimetre.

If we throw into the telephone currents of different intensities, but very small, and none of which produces a displacement of the rings beyond half the distance which separates them, we may, by considering a point of the glass plate infer from its brightness the intensity of the current. This singular galvanometric procedure might, without doubt, be utilised in a telectroscopic receiver.—*Comptes Rendus.*

ON THE CHEMICAL WORK EFFECTED BY THE BATTERY.—By M. D. Tommasi.—An element with a mixture of chromic and sulphuric acids should evolve, according to Favre, 117·3 calories, though only 62·5 calories are transmissible to the circuit. It would then result that a single chromic acid element would not decompose water acidulated with sulphuric acid.

In fact, if the positive electrode of this element is of platinum the water is not decomposed; but if the electrode is of carbon or of platinum sponge, electrolysis takes place. The chemical reaction produced within the element being always the same, I have sought to determine approximately, by means of electrolysis, what is the number of calories transmissible to the circuit by a chromic acid element, according as its positive electrode is of platinum, of carbon, or of platinum sponge.

(*a.*) *Chromic Acid Element with a Platinum Electrode.*—This element does not decompose water acidulated with sulphuric acid if the electrodes of the voltameter are of platinum, but the decomposition takes place if the positive electrode is of silver. A chromic acid element and a Regnault element decompose water with platinum electrodes to the voltameter.

A chromic acid element decomposes the water contained in two voltameters if the two positive electrodes are one of silver and the other of copper. Hence the electromotive force of this element must be intermediate between 62 and 69 calories. The number of calories transmissible to the circuit, as given by Favre, 62·5, thus closely approaches that found in a different manner. It is a singular fact that an element which liberates 117·3 calories should not transmit to the circuit in the form of electric energy more than 70 or at most 72 calories, as otherwise it would decompose water acidulated with sulphuric acid. I will return to this question when speaking of an element with oxygenated water which presents the same anomaly.

(*b.*) *Chromic Acid Element with a Carbon Electrode.*—The water of the voltameter being acidulated with sulphuric acid, there is electrolysis either with both electrodes of platinum, or with a negative electrode of platinum and a positive of copper. This element, if associated with a zinc-platinum element in dilute sulphuric acid, ought to decompose if its electromotive force is really = 117·3 calories. These experiments show that the electromotive force of the chromic acid element with a carbon electrode should not be less than 82, nor greater than 90 calories.

(*c.*) *Chromic Acid Element with an Electrode of Platinum Sponge.*—The chemical work produced by this element is sensibly equal to that produced by the former element, whence its electromotive force should be estimated at about 8 (85 ?) calories.

It results from these experiments that the chromic acid element, as employed by Favre—that is to say, with a positive electrode of platinum—only produces an exterior chemical work of 65 calories.

If we substitute for platinum in the same element carbon or platinum sponge, we may render 85 calories transmissible to the circuit.

If we compare the electromotive forces of chromic acid elements as determined by means of physical procedures, we find, according to the nature of the positive electrode, the following values:

Carbon = 1·574, platinum = 0·977, copper = 0·961, platinum sponge = ?

The decrease of the electromotive force observed in the chromic acid element with a copper electrode is because this metal being attacked by the mixture of chromic and sulphuric acid, even if the circuit is open, occasions a current in the opposite direction to the primary one. As for the electromotive force of the chromic acid element with an electrode of platinum sponge, it has not yet been determined; but we may foresee, according to what has been said, that it will probably be very near to the electromotor force of the chromic acid element with a carbon electrode.—*Comptes Rendus.*

ON THE CHARGE OF DIELECTRICS.—By MM. Villari and Righi.—Villari had observed that on lashing one side of an ebonite plate it was charged, as is generally known, negatively, whilst the other side without contact with a conductor took a positive charge, the opposite of what is generally supposed. Righi, on the other hand, found that the latter charge only appears after the lapse of some time and is therefore secondary. On repeating the experiments together, when the anterior surface was rubbed with cat-skin and then laid upon a plate which had been previously discharged, the lower surface when examined by means of a mixture of red lead and sulphur or of a test-disc was generally found positive. If the experiment is performed rapidly or if the ebonite plate is heated or thoroughly dried over chloride of calcium it appears negative. If exposed for some time to the air it is positive again. The latter charge is therefore secondary.—*Wiedemann's Beiblätter.*

ON THE LUMINOUS AND SPHEROIDAL PHENOMENA WHICH ACCOMPANY THE ELECTROLYSIS OF LIQUIDS.—By M. Slouguinof.—It has long been known that under certain circumstances electrolysis is accompanied by luminous phenomena at the electrodes, but these appearances have till lately remained almost unnoticed. It has been established that light appears at the electrode with which the circuit of a battery of many elements is closed by plunging it into an electrolyte already connected with the other pole of the battery. The author has found that if two equal electrodes are plunged unequally deep into the electrolyte, on closing the circuit of a sufficiently powerful battery a luminous phenomenon appears at the electrode which is less deeply immersed. This electric luminosity may be of two kinds, one of which is a consequence of the spheroidal state which the liquid assumes at one of the electrodes in consequence of the action of the current. Just as metal when raised to a high temperature repels any liquid which is brought in contact with it, so a liquid is repelled by a metal which is being traversed by a powerful galvanic current; in other words, both heat and electricity can throw a liquid into the spheroidal state. Both these agencies may occasionally act conjointly. The electro spheroidal condition is accompanied by a faint luminous appearance. Besides this electrolytic light there is also a luminosity of another kind, and if it takes place at the cathode, particles of platinum are detached from this electrode. In case of the development of light at the cathode and in a solution of platinum chloride in hydrochloric acid, the intensity of the light depends on the heating of the platinum powder which is there separated.—*Carl's Repertorium der Experimental Physik.*

A GALVANIC ELEMENT.—By C. Baudot.—The author modifies a Bunsen element by using, instead of one earthenware cylinder, two, the one placed in the other, both filled with nitric acid. The carbon is placed in the interior vessel.—*Wiedemann's Beiblätter.*

IMPROVEMENTS IN SECONDARY GALVANIC BATTERIES.—Amongst the many practical or unpractical proposals for the construction of secondary batteries, must be included the following:—

The electrodes, formed of spirally-coiled polished plates or wire brushes, *e.g.*, of silver, plunge into a vessel filled only to a little depth with water, but chiefly with oil. The oil is to form a badly conductive coating upon the electrodes, so that the cell may charge itself electrostatically. For the electrodes may be substituted baskets filled with coke, or two strata of coke separated from each other by wadding.—*Wiedemann's Beiblätter.*

NEW PATENTS—1882.

3779. "Electric lamps." B. J. MILLS. (Communicated by W. M. Thomas.) Dated August 9.

3795. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated by J. B. Wallace.) Dated August 9. *Complete.*

3802. "Secondary batteries." C. T. KINGZETT. Dated August 9.

3803. "Telephonic apparatus." S. P. THOMPSON. Dated August 9.

3812. "Electric secondary or storage batteries." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated August 10.

3813. "New apparatus for regulating and measuring electric currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated August 10.

3814. "Electric lamp apparatus." H. J. HADDAN. (Communicated by C. F. Brush.) Dated August 10.

3815. "Improvements in type-writers and in the method of producing symbols by the same; also applicable to printing telegraphs." H. J. HADDAN. (Communicated by B. Schmitz.) Dated August 10.

3820. "Magneto-electrical apparatus for signalling on railways." J. H. JOHNSON. (Communicated by F. and J. Ducousso and the Société Anonyme Maison Breguet.) Dated August 10.

3821. "Electric lamps." F. MORI. Dated August 10.

3822. "Batteries for the storage of electricity." F. MORI. Dated August 10.

3824. "Meter or registering apparatus for the electric light." A. M. CLARK. (Communicated by L. Hours-Humbert and J. de B. de Liman.) Dated August 10.

3825. "Electro-motors." S. H. EMMENS. Dated August 10.

3827. "An improved vessel or station for automatically compressing and storing air by the action of the waves of the sea, and also for the generating of electricity by means of this compressed air." C. W. HARDING. Dated August 10.

3834. "Regulating electric light." H. WILDE. Dated August 11.

3842. "Suspending telegraph wires from iron posts." H. C. JOBSON. Dated August 11.

3846. "Regulating electric currents." W. S. SMITH. Dated August 12.

3856. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated by N. E. Reynier.) Dated August 12.

3861. "Electric incandescent lamps." G. PFANNKUCHE and A. A. DIXON. Dated August 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

5668. "Dynamo-electric machines, &c." SIR WILLIAM THOMSON. Dated December 26. 1s. 10d. Consists of improvements in dynamo-electric machines, and which may be employed either for generating electric currents, or for developing mechanical energy from electric currents. One of these improvements consists of a revolving metallic brush, to perform the functions of the fixed metallic brushes or combs which have been hitherto generally used for making the contacts with the commutator bars. By means of this brush the desired effect is produced with but little friction, the mechanical action being chiefly rolling. The requisite rigidity, or quasi-rigidity of the roller is given partly by the elasticity of its constituent metallic parts, and partly by centrifugal force. [This is an important patent.]

1882.

14. "Apparatus for electric lighting." ANDREW MACKIE. Dated January 2. 6d. Relates to an improved incandescent lamp constructed with two or more filaments enclosed in an exhausted glass globe, and to which there is connected a regulating arrangement whereby any surplus currents of electricity over and above that required to make a single filament incandescent is shunted into the next filament or filaments, according to the strength of such excess of current, thus preventing any one of them being overheated and destroyed, and admitting of the illuminating power of every lamp in a circuit being increased by simply increasing the main current to a suitable extent. In carying out this invention the inventor proceeds as follows. All the positive terminals of the filaments in the globe are connected to studs let into a piece of insulating material, the studs being fixed at a certain distance apart; the branch positive conductor from the main lead being attached to the first of the studs. On the first stud there rests a sliding contact piece of such size and shape that when moved to the necessary extent it can cover and make contact with the whole of the studs. This contact piece is attached to a spindle connected to the armature of an electro-magnet, a small spring being arranged so as to press the armature away from the magnet. When a normal current on its way to stud No. 1 passes round the coil of the electro-magnet, this latter overcoming the pressure of the spring attracts the armature and so draws the contact piece into close proximity to the second stud; but should an excess of current occur either accidentally or intentionally, such excess over and above the normal current will draw the armature still closer to the magnet, and so cause the contact piece to slide over and make contact with one or more studs according to the amount of such excess of current, thus throwing the corresponding filaments into action.

29. "Secondary batteries." D. G. FITZGERALD and C. H. W. BIGGS and W. W. BEAUMONT. Dated January 3. 2d. Relates to the improvement of secondary electrical batteries. According to one part of the invention electrodes are obtained having an increased surface or porosity by utilising what is known as local action occurring between lead and a metal electro-negative to lead. The electrodes are obtained by depositing on or in plates of lead or of lead alloy by chemical, electro-chemical, or mechanical means, a metal electro-negative to lead, such metal being in most cases subsequently removed preferably by making the plate an anode in a solution which does not form a soluble salt of lead. (*Provisional only.*)

49. "Measuring and recording quantity of electricity," &c. JOHN HOPKINSON. Dated January 4. 6d. Relates to the methods of measuring the whole quantity of electricity which passes through a conductor. For this purpose the inventor makes use of a centrifugal governor or centrifugal apparatus and controls its velocity by electrical or electro-magnetic apparatus. The centrifugal force of the governor may be opposed by the attraction or repulsion of one conductor conveying electricity on another conductor conveying electricity, of an electro-magnet for its armature or of a solenoid for its core. Or the centrifugal force may move one contact piece or its equivalent and the electrical apparatus a second contact piece in such wise that as the speed of the governor increases the former piece or its equivalent is moved from the second whilst as the electrical force increases the second piece follows up the first. When the centrifugal force is mechanically opposed to the electrical force the governor may act by bringing a friction brake into action or it may act by making and breaking an electrical contact. The governor may be driven by a small dynamo-electric machine or in the case of using a brake the governor may be driven by clockwork.

55. "Apparatus used in the distribution of electrical energy." JOHN PERRY. Dated January 5. 4d. In the distribution of electrical energy from a central source it is very important that any person to whose premises conducting wires are laid should get a supply which is quite independent of the demand from and supply to other consumers of power. The inventor's method is to use one or more magneto-electrical machines or some other form of electrical machine or battery which will produce in a circuit an electromotive force which is constant and independent of any other electromotive forces in the same circuit, and in addition to this to have in the same circuit one or more dynamo-electric machines.

64. "Magneto and dynamo-electric machines." LORENTZ ALBERT GROTH. (A communication from abroad by R. J. Gülcher, of Austria.) Dated January 5. 6d. Has for object the reduction or obviation of the injurious heating of the wire coils, and thereby the production of an increased useful effect in the machine. According to these improvements the inductor rotating between the magnetic pole surfaces consists of a ring, the core of which is formed of separate magnetically insulated strips (Lamellen) of soft iron in order to facilitate the change of the magnetic poles during the rotation of the ring, and thus to reduce the heating of the ring itself to a minimum. The section of the ring differs materially from those of other machines, being either of a wedge shape, that is, triangular, or of a wedge-shaped pointed square or rectangle. This form not only permits of a convenient and solid fixing of the inductor, but also allows the wire bobbins wound round such a ring to be exposed to the inducing action of the magnetic pole surfaces from all sides, and thereby completely obviates the production of heat, which in other machines is formed in the passage of the electric current through the unexcited wire parts. The magnetic pole surfaces are formed in all their parts of a U-shaped section, and enclose the rotating ring in such manner that the legs of its cross section project out on both sides over the wedge-shaped points of the section of the ring, and the latter is thus exposed on all sides to their inducing action.

69. "Manufacture of incandescent lamps." E. H. T. LIVEING and C. V. BOYS. Dated January 6. 4d. Relates to modes of manufacturing incandescent lamps, whereby their expense is reduced or their conducting threads more easily replaced when damaged or destroyed. In the first class of lamp, where cheapness is obtained, the inventors avoid the use of the platinum wires sealed in the glass which have hitherto been employed in vacuous lamps to make electrical connection with the carbon thread and the wires outside, and use instead a pair of conducting wires, suitably insulated, passing through a narrow tube or tubes sealed on to the globe, and they prevent the entrance of air into the globe through the tube by partly filling it with well-boiled pitch, or other resinous or suitable cement, which will not give off sufficient vapour to injure the lamp.

71. "Automatic electric-printing registers, &c." A. J. BOULT. (A communication from abroad by B. E. Valentine, of New York, America.) Dated January 6. 10d. Consists of automatically receiving and forming a permanent register of electric signals. It consists of one or more transmitters, or signal boxes, for sending signals by the breaking of a circuit. The chief features of the signal-box being a revolving wheel, having on its first quarter the notches to denote the nature of the signal. On the next quarter and on the third quarter notches to denote the number of the station whence the signal is sent, and on the last quarter an independent contact surface to switch a main circuit through a bell magnet to enable a return signal to be sounded at the transmitter.

72. "Secondary or reversible electric batteries." RANKIN KENNEDY. Dated January 6. 2d. Has for its object to improve the construction and action of secondary or reversible electric batteries. A battery made according to the invention consists of one or more vessels, each of any convenient shape, made of wood or other suitable non-conducting material, and capable of holding a quantity of dilute sulphuric or other suitable acid. Immersed in the dilute acid there are plates of lead, tin, iron, or other suitable metal, or of conductiug carbon, prepared in such manner as on being charged by an electric current from

a dynamo-electric machine or other source to become the receptacles of oxygen and hydrogen due to the decomposing action of the current, the oxygen being absorbed in, or in connection with, one kind of plate, and the hydrogen in, or in connection with, another kind of plate. After being charged in this way the battery is capable of being used to supply an electric current. (*Provisional only.*)

95. "Electric lamps." W. J. Mackenzie. Dated January 7. 6d. Relates to improvements in, or connected with, electric arc lamps, which consist (firstly) in special means whereby the feeding of the carbon pencils or electrodes is controlled, and their resistance minimised; and (secondly) in novel arrangements of regulating appliances connected with electric arc lamps, to be used either in combination with, or separately from the first part of the improvements, whereby more perfect regulation of the distance between the electrodes may be secured for the purpose of maintaining the arc steadily.

118. "Telegraphy." Peter Jensen. (A communication from abroad by F. W. Jones, of America.) Dated January 9. 4d. Relates especially to duplex cable telegraphs, and the object is to provide an efficient means for overcoming the disturbing effects of the electrical discharge from the cable upon the receiving instrument at the home or sending station. (*Provisional only.*)

120. "Storing Electrical Energy, &c." J. E. Liardet. Dated January 9. 8d. Has for its object improvements in the means of and in the apparatus for storing electrical energy and in the preparation of the materials to be employed.

129. "Electrically lighting railway trains." W. H. Preece. Dated January 10. 6d. Relates to the lighting of railway carriages by electricity, the object in view being to provide means of generating a practically uniform current of electricity notwithstanding the stoppage of the train or variations in its speed. For this purpose from one or more of the running axles of the train the inventors work air-compressing pumps, so as to charge one or more reservoirs with compressed air. This compressed air is employed to work an engine or engines which work suitable dynamo-electric machines, the air engines having their supply regulated so as to maintain as nearly as possible uniform speed.

144. "Secondary galvanic batteries." H. J. Haddan. (A communication from abroad by Dr. Emil Boettcher, of Leipzig.) Dated January 11. 2d. Relates to secondary galvanic batteries or accumulators, and consists in the application of zinc vitriol as exciting liquid, and of zinc and oxide of lead as electrodes, the action of these elements being as follows:—An electric current from a dynamo-machine passing through a solution of pure sulphate of zinc (one part of the salt to three parts of water) decomposes the said salt, and causes a deposit of zinc on a thin plate of pure zinc, the diluted sulphuric acid (1 to 10) being not strong enough to attack pure zinc. The other pole is formed by thin lead foil, folded several times, in order to augment the active surface, and covered with a thick layer of pure litharge. The oxygen, coming in contact with the said lead foil, produces a very thin layer of peroxide of lead. By closing the galvanic element thus formed, the zinc previously deposited is again dissolved, and thereby the sulphate of zinc produced, while the hydrogen reduces not only the peroxide formed on the lead plate, but also a layer of the oxide of lead, thereby forming metallic lead. If now the current from the dynamo-machine is again passed through the element, a new deposit of zinc is formed on the zinc plate, while on the opposite pole not only the previously reduced peroxide of lead, but also the lead formed from the oxide, is again oxidised into peroxide of lead. By a few repetitions of this process, the secondary galvanic element is completed, and has acquired high electromotive power.

185. "Electric accumulators." H. J. Haddan. (A communication from abroad by Augustin Morel, of Roubaix, France.) Dated January 13. 2d. Has for its object to reduce the weight of electric accumulators, and consists in the application of a series of receptacles provided with two metallic blades or other good conductors which serve as poles for the decomposition of water or other suitable liquid. If an electric current is made to pass through these elements, the receptacles are filed with gas, water yielding one volume of oxygen and two volumes of hydrogen. If now the current is broken or diminished, the oxygen combines again with the hydrogen to form water, thereby yielding the exact amount of electricity which has been previously spent. (*Provisional only.*)

197. "Apparatus for the transmission and reception of sounds." W. C. Barney. Dated January 13. 2d. In order to protect as much as possible a microphone or current regulator from the evil necessarily attendant upon the use of a thin vibratory plate in connection therewith, the inventor places the microphones inside a box made of wood, cork, ebonite, felt, or any equivalent material, the material surrounding the microphone being of sufficient thickness to reduce to a minimum any vibratory movements which the sound waves may give to the material, thus leaving the microphone to be acted upon by the molecular movement of the material to which it is attached. This box is not fixed to any substance, but merely rests on the top of a box containing the induction coil, where it is retained by its *vis-inertiâ*. (*Provisional only.*)

319. "Construction of secondary batteries." J. S. Sellon. Dated January 21. 2d. Relates to the construction of the terminal plates, supports, retainers, or frames upon or in which the active material or agent is deposited, placed, or fixed in the construction of secondary batteries, the object of the said invention being to render the plates, supports, retainers, or frames more durable than as they are ordinarily constructed. In carrying out the invention the [illegible] constructs such plates, supports, retainers, or frames partially [illegible] pieces or rods of any convenient shape or combination of [illegible]tly of, metal, carbon, or of other suitable material [illegible]nductive in itself or can be rendered conductive, on or to which are attached, connected, or affixed, strips or pieces of lead or other suitable metal or material, such strips or pieces being of any convenient form for retaining on the surfaces or in the cavities, interstices, cells, or spaces the active material in a divided, finely divided, pasty, deposited, or other convenient, or desirable condition.

224. "Electric-lighting apparatus, &c." W. R. Lake. (A communication from abroad by J. S. Williams, of America.) Dated January 16. 6d. Relates to the manufacture or construction of electric lamps, candles, or lighting apparatus which will be more durable and efficient than those hitherto provided, and the said invention consists in various improvements as specified.

1437. "Electric accumulator." Sigismund Cohné. Dated March 25. 4d. Relates to a new or improved accumulator for the storage of electric energy (commonly called storage of electricity) for the purposes of electric lighting and electromotive power, whereby the inventor obtains a larger capacity of storage combined with greater efficiency and durability. Hitherto the cells of the accumulators in use are liable to polarise themselves and require a considerable volume and weight, or the electrodes are quickly destroyed. The object, therefore, of the invention is to obviate those defects, and also to simplify the construction of the accumulator whereby it is more readily applicable to different uses.

According to the invention, the inventor applies on the surface of a sheet of lead of any convenient size (by preference about a foot square and about 1-16th of an inch thick), a layer of mercuric sulphide, HgS, say, about six ounces to the square foot, whether amorphous or crystallised, by preference the crystallised HgS, called cinnabar or vermillion is used, and bends the coated sheet into the form of a box or into the form of a spiral, so that the layer cannot be removed by the acid. This prepared sheet is used for the positive electrode. A second sheet of lead rather less in size is arranged and prepared in the same way as the first one, for the negative electrode. Both sheets are perforated and placed so as to be separate or apart from each other into a jar or box filled with diluted sulphuric acid in the usual way, and then charged by the ordinary known process.

DISCLAIMERS.

The Edison Electric Light Company (Limited), "Electric lamps." No. 578. 1880. "Magneto-electric machines." No. 3964. 1880. "Connecting the carbon ends to conducting wires on electric lamps." No. 768. 1881.

CITY NOTES.

Old Broad Street.

THE METROPOLITAN (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

On the afternoon of Friday, the 11th inst., at the City Terminus Hotel, Cannon Street, under the presidency of Sir Michael Kennedy, R.E., K.C.S.I., an extraordinary general meeting of the members of this company was held.

The secretary, Mr. Robert Wilson, having read the notice convening the meeting

The Chairman said: This is a special meeting held merely for the purpose of confirming a resolution passed at the former special meeting. As soon as we have confirmed the resolution we shall be in a position to obtain from the Committee of the Stock Exchange a quotation. We have already, as you are aware, had a settlement. I therefore simply beg to move the following special resolutions, modifying the articles of association, duly passed at the extraordinary general meeting of the company held on the 24th July last be and the same are hereby confirmed:—

1. That the following words be inserted at the end of Article 4: "Provided always that no share shall be issued at a discount without the sanction of a general meeting."
2. That in lieu of "1886," occurring in Articles 81 and 89 respectively, "1884" be inserted.
3. That Articles 85 and 100 be and they are hereby expunged.

This was seconded by Mr. James Whitehead (vice-chairman), and carried unanimously.

Statutory Meeting.

The Secretary then read the notice convening the first ordinary general statutory meeting, which accordingly took place.

The Chairman said: Gentlemen, this is our first general statutory meeting, and, as is usual on such occasions, we have not much to communicate to you. Up to the present time our business has been chiefly the organisation and preparation for the work which is doubtless before us, and which we hope to carry on on a very extensive scale when the winter brings us long dark nights and often dark days. The company was incorporated on May 15th with a capital of £1,000,000 sterling, in 200,000 shares, of which 100,000 shares were first offered. 392,686 shares, or very nearly four times the number offered, were applied for, and the whole number available—100,000—were in the first instance allotted. This number was reduced by 310 withdrawals, which, after full and careful consideration, the directors were constrained to admit upon legal grounds. We engaged suitable, but not extravagant, offices at 110, Cannon Street. One of your first directors, Major Wood, resigned his seat at the board, finding that very onerous calls upon his time in other directions rendered him unable to give that attention to our affairs which their importance necessitated. But the board was strengthened by the accession of Mr. Rose, of the firm of Morton, Rose, and Co., a gentleman well known to you all by reputation at least. We entered into a working arrangement with the Hammond Company, under which we secured the services of Mr. Hammond as our managing director on terms based upon a share of the profits. Mr. Hammond had before gathered together a considerable staff, and had explored,

so to speak, the requirements of the metropolis as regards electric lighting. He had also established a lighting station at Westminster and another in Holborn. Mr. Hammond's reputation as an energetic man of business and a successful organiser of the Brush system must be very well known to you all. We felt that in making this temporary arrangement we did the best in our power to provide for a successful starting of our operations. We appointed Mr. Wilson, a gentleman who has had great experience in public companies, to be our secretary. As soon as our organisation had been completed, we proceded to lay the foundation of the extensive business which we trust is before us. We advertised in all the newspapers; we gave a wide circulation to the pamphlet prepared by our managing director, giving prices of plant and machinery, estimated cost of installations, &c. Up to the present time our work has been confined mainly to small private installations. As regards public lighting, although we have been in communication with many authorities, we have found that on their part they have an objection to make any movement till the Electric Lighting Bill has become law. All those gentlemen who are concerned in electric lighting must have followed the course of the bill with a considerable amount of interest, though perhaps also with a little apprehension. I was prepared to address you in somewhat different terms to those I shall now have to adopt, for I am happy to inform you that in Committee of the House of Lords on Tuesday the bill underwent considerable and material modification. The terms for which licences can be granted with the assent of the local bodies was altered from five to seven years, and the period for which provisional orders can be granted from fifteen to twenty-one years. This is no doubt a considerable concession. But the objectionable clause of the bill is a compulsory sale clause which still remains in it in the inequitable terms, if I may so express myself, in which it was first drafted; and it is to this point we shall have to direct our future efforts. Under this clause, as you are well aware, electric light undertakers are liable to be compelled to sell their plant and property at the end of the period for which a provisional order has been granted for the mere price of the materials, without taking into consideration anything regarding the goodwill of the concern. This I consider very bad. But it might have been justified to some extent had there not been in the bill a clause which regulates the price at which electricity shall be supplied to consumers. The existence of this clause restrains electric undertakers from making large profits, while the sale clause compels them to sell their property at a time when in all probability they had begun to reap the fruits of their enterprise. As regards our action under the bill we have matured the steps that we shall adopt and which we intend to take as soon as possible. It would not be advisable for me to make any detailed statement of what those steps are. All that I can tell you is that we have arranged what shall be done, and to lose no time in doing it. It is very encouraging, gentlemen, to find that there is a general and growing opinion that the electric light enterprise has before it a great and immediate future. Wherever the subject is discussed, whether it be in Parliament or out of Parliament, or in the columns of the public press, the sentiment is almost universally expressed. In an article in the *Times*, of the 17th July—I don't know whether you have all seen it—there are words to the effect that, "there is a vast field of electric work, and so far from having to educate the public to the use of electricity, as some seem to contemplate, those who are concerned in its distribution will soon be applied to by more customers than they can deal with." This, gentlemen, has up to the present time been our own experience. We have joined also in a very important movement. You are aware that there are many companies who derive their licences, as we do, from the Anglo-American Brush Corporation. We have thought it advisable to join a conference of those companies, their boards having agreed to send delegates to form a council. Our licences are similar but our districts entirely distinct. We have a common cause and no conflicting interests. We therefore thought that for united action and protection of common interests, a council of that description would have a very important effect in protecting the Brush interests. Already the council has met and arranged its procedure, passed important resolutions as regards the quality and price of plant and material, which it receives from the Anglo-American Brush Corporation. These, gentlemen, are all the remarks I have to make, and if any gentleman has any questions to ask I shall be glad to answer them to the best of my ability.

Mr. Campbell asked whether the 310 which were withdrawn were subscribers or shares?

The Chairman replied that they were shares, not subscribers.

A shareholder asked if the company were doing any business at the present time?

The Chairman said they were doing business in many directions.

The shareholder, continuing, said they held meetings occasionally, but he thought they heard nothing definite.

The Chairman answered that they were preparing to do business when business arose. They were doing business to a very considerable extent, and he might mention from memory, Covent Garden.

Another shareholder: You are earning money at the present time?

The Chairman: Yes, sir.

Mr. Price said he thought many of the shareholders were dissatisfied, and he should like to ask a question or two. The Camberwell Streets Committee asked for tenders to light with electricity the streets in their district. Only one tender was sent in. Was it theirs? And if not, why did they not tender? Did they possess the right to manufacture their own carbons, or were they manufactured in New York and sent over here? As there seemed to be a doubt as to whether electric lighting could compete with gas in regard to price, he should like to ask whether the last tender would be remunerative for lighting certain districts in the City? Were the lighting of certain railway stations in the metropolis remunerative contracts? He should be very pleased with a plain answer.

The Chairman thought that all those questions could be very easily answered. As his friend, Mr. Hammond, was more acquainted with the practical details of those matters, he would ask him to reply.

Mr. Hammond said, as the gentleman before the previous speaker had asked a question which involved a great principle in the business of the company, he might be pardoned if he dealt with it as well as the chairman. An electric lighting company, in its initial stage, had a great deal of ground to cover in the way of preparing for business, and if they got no fruits from them they would certainly be in a great mess. One was also anxious not to be too closely questioned as to the mode of organisation they had pursued in the metropolis, though he should like to make them as enthusiastic as he was himself as to what was being done in a quiet manner to cover the whole place. If he were to take them into the office and show them the streets all named, the traveller of each put to them, and the days upon which they visited these districts, they would form some idea of how the districts were being covered. They did not want to tell their friends outside all they were doing; but he could assure them there was no spot in the metropolis that was not being covered by this company. That preliminary work was being carried out with as little expense as possible, and they felt that where £1 was spent in this manner they would get back £3 in its place. Their time up to the present had by no means been lost. In the matter of grouping together districts, and the hiring out of lights, it was their policy to get the customers first and then put down central stations in the midst of them. He felt that amongst friends he must ask their forebearance, because he could not say too much. He could not, however, sit there and hear a hint that they were spending money to no purpose. That was not so. With regard to the Electric Lighting Bill, he might say they did not like it. However, they were glad to see that the Lords amended the compulsory purchase clause from fifteen to twenty-one years. For his own part he was now satisfied with the bill as a preliminary piece of legislation in this line, and he hoped that by next year it would be considerably improved in their favour. Personally he felt that the bill should go on, rather than that they should block it. There was a certain work connected with the bill which would prove of immense value to this company. They were conscious of that, and he said no more. The one tender sent in to the Camberwell vestry was that sent by this company. That tender, if it had been accepted, would have formed the basis of the systematic lighting of Camberwell, which would have left a considerable profit to this company. He would be the last man in the room to dodge the question asked, but he must say that if they were to have to put down gas mains merely to light a certain place, and were not allowed to light places *en route*, it would be done at a great loss. Gas companies put down a main, and said to themselves "we shall have the lighting *en route*," and they put the price down; otherwise the price per 1,000 feet would be 21s., or five times the ordinary charge. What was asked for with regard to the gas question, they asked for the electric light. They said: "get this light and you will get that." They based their price upon what would be remunerative when the whole thing was a going concern and in fair working order. If they did not adopt that principle, they would ask such prices that the vesteries would not listen to them. He was careful to put in that tender that the company would only do the lighting on condition of having the lighting *en route*, and after one year. They would not give the company the lighting *en route* after one year. Everything with regard to that tender was considered from the point of view of the interests of the company. With regard to carbons, he was glad to tell them that the company had every power to get their carbons in the cheapest market, but they were bound to the Brush Company for their machine and lamp; although, as a matter-of-fact, they found it convenient, considering the organisation the Brush works had, and the apparatus they had, to go to them for materials; yet in carbons they were perfectly free. As a matter-of-fact, at the moment, they went to the Anglo-American for their carbons; this company had an arrangement with them whereby they could buy on cheaper terms than they could get them from anybody else. He believed it was true that the Anglo-American Company got their carbons from America, in doing so they got them under very special terms with the patentees there, who had the right to make them in that particular manner. He could assure the shareholders that the directors kept a serious eye upon that question. The man who got the lighting generally got the order for the trimmings required afterwards. If they were to light the hotel in which they were assembled, which was quite within the bounds of possibility, they would probably get all orders for trimmings, carbons, &c., afterwards. He could dispose of the third question by saying that this company did not tender for lighting in the City, but that would only be a technical way of meeting the question. The City tenders were closed the day before this company had its capital subscribed, and it was therefore impossible for the company to tender. A tender was put in on behalf of the Hammond Company, and an arrangement was made between that company and this that they should have a mutual benefit. He had really answered the question as to the remunerative part of this undertaking in his answer concerning Camberwell. The undertaking would have left a profit if they could do the lighting by their mains *en route*. With regard to certain other lighting in the City, with one exception, the railway companies, after a trial of the plant, have paid for it, so that no question of yearly profit arose, except the profit which arose from supplying carbons. The Great Eastern Railway Company tried the light, and finding it worked satisfactorily, gave a cheque for the amount. The only station which was not in that position was Charing Cross, and in that case the parent Brush Company was running that station for the cost of the gas bill, in order, primarily, thoroughly to show what its system could do. They were running it under such favourable circumstances that they felt themselves recouped by the gas bill; for instead of having to put up a separate installation they were running it from their works at

Lambeth, a thing which was only possible with the Brush system. When they went to Lambeth and saw the whole lighting done from one machine, through five miles of wire, and when they went to look at an opponent's system, which required for the same amount of lighting thirteen dynamo machines and eighteen wires, then they saw that the Brush was ahead at the moment of every other system, and would, they hoped, remain so. The position at Charing Cross was simply turning the power, which otherwise would drive a lathe, on to a dynamo machine.

In reply to a question, Mr. Hammond said that the lighting of Charing Cross and the City was the only piece of Brush lighting not done by the Metropolitan Company.

The Chairman, in answer to a question as to the concession received by this company from the Hammond Company, stated that the Hammond Company had received a concession for the City of Westminster, and they had also a lighting station at Holborn; and it was in order to extinguish these rights that an arrangement was entered into with the Hammond Company.

Dr. Rosenthal said he should like to ask what was the position of the company with regard to satisfying the want of an independent secondary battery, or accumulator; for he felt that in future an accumulator would be quite as important an element in their work as the dynamo machine.

The Chairman replied that the consideration of an independent accumulator was engaging the very earnest consideration of the board. There were the Faure, Sellon-Volckmar, and other accumulators in the field, but the policy of the directors with regard to this matter had been one of waiting, because they were not quite satisfied with the efficiency of those accumulators. They had very good hopes and expectations that the results which had hitherto been obtained from the accumulators now considered the best, would be excelled by others; and they had therefore felt disinclined to pledge their capital in that which was good now, but which was likely to be superseded by something better.

Mr. Bigg said he should like to ask a question or two. He had understood that 390,000 shares had been applied for, and 100,000 were allotted, and 310 were withdrawn. Was the £3 paid upon the remaining 100,000? Did the directors of this company themselves take a large interest in the undertaking?—for that would inspire the shareholders with a great deal of confidence—or did they simply take their qualification? What prospect was there of their making a further call? He found that their shares could be obtained at 1¼ discount, and he thought any further call would be ruinous to their finances.

Mr. James Whitehead replied, with the chairman's permission. He said that out of the total sum called up, of £300,000, there only remained £3,645 unpaid. And while he was on his feet, he should like to reply perhaps more fully, if Mr. Hammond would excuse him, to the question put by a gentleman in the body of the meeting, with reference to the price of electricity, as compared with gas, in the City. He did not know whether all those who had considered the question had fully taken into account the very large extra amount of light given to the public by the electric system. For the sake of argument, they would compare themselves with the gas burners, according to the improved system, with an extra consumption of gas, and the effect of that would show that in the four districts for which this company tendered through the Hammond Company, in the City, the cost of gas would be £7,250, which was more than double their tender for electric lighting—for their tender was for £3,725, allowing £725 for wear and tear. With reference to the Electric Bill, they had felt that the compulsory sale clause was not only unfair to this company but to all electric lighting companies. He did not want to depreciate the value of their property, but he thought if they could get the present bill altered so that they could get a fair chance against gas, then they would be able to make this company a successful undertaking, not only so far as electric lighting of the metropolis was concerned, but also financially. He wanted the shareholders to realise what were the difficulties under which they laboured with reference to the compulsory sale clause as it stood at present. They paid £235,000 for the exclusive right to use the Brush and Lane-Fox patents in the metropolitan area. If, for the sake of argument, they spent another £265,000 in plant, making the £500,000 of issued capital, and if at the expiration of twenty-one years their property was to be taken for the simple value of the machinery, they would see that the £500,000 must be provided for before the expiration of the time when it might be taken over by the local authorities. That was a very serious business. If they said for the sake of argument—of course all this in the present state of things was highly hypothetical—after the expenditure of £265,000 in plant, they had to provide for a total of £473,500 to liquidate the amount expended before the expiration of the twenty-one years, during which they had exclusive right of using these patents in the metropolitan area, and if they assumed that during the twenty-one years they had fifteen years of good work, and divided that sum by fifteen, they would find that they had £31,566 to provide for yearly, besides the usual amount for repairs and wear and tear. He wanted to show them the necessity of putting their shoulders to the wheel in order that they might obtain fair, and equitable and just, rights to enable them to compete against the gas companies already in the field. He thought this was a question which concerned not only the shareholders of that company, but concerned seriously the interest of the general public throughout the entire kingdom. Very few of them would contest the point for one moment that the electric light was not superior in every respect to gas; it was not only more brilliant but it did not affect colours by night; it gave exactly the same light at night for the judging of colours, and in consequence was of great benefit to trades in the kingdom, especially in drapery; but it was also a more healthy and wholesome light, and did not injure their pictures or curtains.

In reply to a further question from Mr. Bigg,

The Chairman said he was not in a position to state what was the interest of the directors in the company. The register was open to the inspection of any gentleman who chose to look at it. He believed the directors had a substantial stake and interest in the concern. As regarded the question in reference to a call, he might say there was no intention to make a call, and no call would be made until the progress of the business was sufficiently advanced to justify it. He hoped, however, they would have occasion to make a call speedily, but they would not do so until they had a good use for the money.

Mr. Hammond said, that in order that his previous remarks might not be misapprehended, or that he might not be thought to differ from his colleagues, he should like to add that he was only satisfied with the Electric Lighting Bill as an instalment of legislation in this matter. He should like to read one clause from which he took a grain of comfort; and he hoped that grain would extend to a tree, under whose branches they might eventually rest contented:—"Thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials, and plant of such undertakers." "The fair market value" was mentioned. They were not to have quite "old iron price," as one noble lord put it, for there was to be taken into account in the sale a great deal of work, of labour involved in laying down mains, &c., which was so much an element that it should be included in the fair market value of the concern. He was quite willing to note the words which had been pointed out to him: "Without any addition of compulsory purchase, or of good-will, or of any profits which may or might have been or made from the undertaking." He did not think that the two conflicted, but it was well that the shareholders should know that there were two views in Parliament in regard to the bill. He was anxious that all doubts in the matter should be removed by next year.

Dr. Pocock asked whether this company would exhibit at the approaching gas and electric exhibition at the Crystal Palace. It seemed to him that the public mind wanted a great deal of education in the matter of electricity, and he should quite approve of their making experiments to show that they had something good to offer.

The Chairman, in reply, said he thought that if any steps were taken to exhibit, the proper persons to do so would be the parent Brush company—the Anglo-American Company. He was glad to find that the shareholders were with the board in the matter of experiments.

A vote of thanks to the chairman, proposed by Mr. T. R. Denny, and seconded by Dr. Rosenthal, closed the proceedings.

BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND (LIMITED).

The first general meeting of the above-named company took place at Cannon Street Hotel, on Wednesday afternoon. In the unavoidable absence of Lord Crawford, Chairman, the Hon. Ashley Ponsonby, Vice-Chairman, presided.

Mr. F. M. Brockelbank, Secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, I have not very much to say. We meet to-day for the statutory meeting in conformity with the regulations of Parliament. I am very glad we have had the opportunity of meeting, because there may be many questions asked which we shall be happy to answer to the best of our ability. I may tell you that the Brush Electric Light Company of Scotland was incorporated on the 25th April, and the issue was made to the public on the 27th April this year. The capital was £300,000 in 60,000 shares of £5 each, of which the first issue was £150,000. 8,000 shares were reserved in part payment for the concession by the vendors, and the remainder was offered to the public. We never had, I suppose, in such a company so large a subscription. You will see, then, when I tell you that we had 22,000 shares to offer to the public. We had subscriptions for these representing 373,553, so that you can see the difficulty of allotment. I believe there was some little feeling of irritation that we did not allot quite satisfactorily, but I assure you we did not know what to do in view of the enormous number of applications. We had 2,677 shareholders, which is rather large in so small a company. Now, gentlemen, you may congratulate yourselves on another fact, that you have your settlement and your quotation on the Stock Exchange. I believe many other of the companies who came out have only one or neither of these, which will show you that in our case everything was done to the approval of the Stock Exchange committee, everything was above board, and satisfactory—a matter very pleasing to the shareholders. The secretary reminds me that I have said we have now 2,000 shareholders on the list, there were 2,677 applicants, and now we have 400 or 500 shareholders. I made a mistake by taking the number of applicants as shareholders. We have no intention of issuing additional capital at present, but of course that question will depend on the work we get in Scotland. We are getting applications for tenders for our work daily, and I hope very shortly to be able to show you a very good report of what work is doing and is to be done. You must remember we have been delayed very much in our action by the law proceedings in Scotland, with regard to the liquidation of the old company that is now perfectly finished, so our solicitor tells me. We could not undertake the election of officers or the beginning of work, or of tenders of any sort or kind until we were perfectly sure that we had everything in shape. As you will see in the book now in your hands, we have appointed as our chief electrician and manager in Scotland Mr. Beckingsale, of whom we have the highest testimonials; and we have appointed also Mr. Brockelbank as our secretary; and Mr. Wylie our agent in Edinburgh; and we have another gentleman, Mr. Martin, in Dundee. These are most energetic and urgent in pushing forward the business, and the board of directors are perfectly satisfied with the working of the company in Scotland. Scotland, you may remember, has an advantage over many other places from its abounding in water power. Water

power exists in nearly all large private houses and factories, and this is of immense importance, because when you have the water power you reduce the cost of the electric light to a minimum; whereas, if you have steam power only, you have to add an expense which does not always contrast favourably with gas lighting. Therefore I always look on Scotland as best adapted for the electric light; hence the good field we have. I shall be very happy to answer any questions, as it is not my intention to delay you long.

Mr. J. Walker: Have you done any work in Glasgow, Edinburgh, or Dundee?

The Chairman: We have at the Waverley Station, Edinburgh.

Mr. Walker: It is some time since the company was started. I thought you would have pushed forward more quickly than you have done. Will you explain what is meant by liquidating the old company? It is the first time I have heard of any old company.

The Chairman: We are lighting the Waverley Station, that is, the central station in Edinburgh. We have tenders out for the lighting of the Tay Bridge Station and others for the East Station in Dundee. We have now mills sending up for tenders, and hope shortly to be able to do business in that direction. The Scotch people are very careful; they don't like to jump in the dark. They like the light before they jump.

Mr. Walker: Is it a profitable contract you have, do you think?

The Chairman: We believe it to be so. The Chairman then read from the prospectus the contracts that had been made with the Scottish Brush Electric Light Company, the company who sold their rights to the present company.

Mr. Walker: Has there been any difficulty between the two companies?

The Chairman: Not between us. I do not intend to enter into other people's business. There was a disagreement between that company and the Anglo-American, who are partial vendors to us. They disputed the appointment of a liquidator, and occasioned application to the courts of law, causing considerable delay to us; but there is no hostile feeling with us.

Mr. Walker: Has it entailed any cost to this company?

The Chairman: The solicitor will tell you. I believe nothing at all. They only sold to us, as vendors.

Mr. Walker: I think this should have been mentioned in the prospectus.

The Chairman: I have just read the prospectus.

Mr. Walker: Oh, I had not seen it. Is the price stated?

The Chairman: Yes, in the agreement. It was £15,000 cash and £40,000 fully paid-up shares. It is the similarity of names that has caused a great deal of confusion. People have been wanting to know if we were winding-up, and all sorts of things.

Another Shareholder: I believe the answer just received from you, Mr. Chairman, with regard to the working, is not altogether satisfactory. You started in May. You have done nothing yet beyond the lighting up of stations. You say you are going to do a great deal, but why is not more done? Then, I must say, we have received a very fair statement, but we expected more to be done. The liquidation of the old company ought not to interfere with the progress of our business. The difficulty was simply with regard to the transfer of money received by them from us. I am sorry to see we gave £55,000 for our patents; this amount, if you consider the merits of the system, is an excessive price. You stated in your prospectus that the object of the company was for the purpose of lighting up public streets, public buildings, and private houses. Now, sir, so far as I understand, you are not in a position to light up private houses, that is, you are not able to compete with gas, for the simple reason that you do not possess all that is necessary to compete with other systems, your system being, of course, incomplete. I refer more especially to a very important thing, that is a secondary battery or accumulator. Is that included in the Brush system? I do not believe it is, and without it you cannot complete the lighting of private houses. It is a matter of impossibility, if I can rely upon the opinion of those who ought to know. The speaker said he had been alluding to a speech of Lord Crawford at a recent meeting of the Oriental Storage Company (cries of "Question"). When you said the object of this company was to light up streets and private houses, of course I understood by your system you would be able to do it. Now, such a statement is misleading, and you mislead me for one to subscribe to the company. I would not have subscribed had I known the system was incomplete; and I believe this is the explanation of the shares being at a discount. Then I believe that the majority of the directors of electric light companies are too fond of blaming the purchase-clause of the new Act. Now, sir, I do not believe but that that clause will be amended at some future time; but, of course, it is better—(cries of "Question")—than to be without a Bill at all. Yet I would like to know are all the shares allotted? Have the directors a substantial interest in this company beyond that required to qualify for director (hear, hear).

Mr. Dickson rose, at the request of the chairman, to answer the last speakers. He said: From the time the company was incorporated and the shares allotted, we had of course to face the difficulty mentioned through the liquidation of the old company; and although it has been said that we ought to have gone and plunged into work rapidly, I think that as prudent men we were justified in waiting a little until we saw how those disputes between the Scottish and Anglo-American Brush Company were settled. We had nothing to do but to look out for the shareholders' money, and we would not part with it until the lawyer satisfied us. It would never have done to plunge into work finding we had a lot of lawyers tied to our necks; it would not have been satisfactory at all. With regard to the second question asked, it was known that we were taking over the concession of the other company in Scotland, who had been working before us. We had to see our shareholders well protected. The gentleman who spoke second said we had paid a large sum for concessions—£55,000. But we have not paid that. And I take it that if you will add all the concessions made, the negotiations prove our company not to have got the worst bargains ever obtained. For £15,000 cash we got clear of preliminary expenses, such as advertisements, lawyer's charges, and brokerage. In that direction a great deal of money often is spent. The rest of the £55,000 was paid in shares, and the bulk of the shareholders' money is therefore still in the bank intact. In the third place, as to our going into work. Now, we all know that in the height of summer it is not the time when people rush into light; it is when the dark nights come in that people become sensible that they would like something better than gas. Across the border people are very careful in these matters. When we floated our company, the Crystal Palace show and exhibition was being held. People naturally said, "We will not go in for this till we see which is the best." At the Crystal Palace we were asked to show the Brush system, and I believe Scotch people went away satisfied that that system was the best. But we did not push the business until we saw our way a little clearer. Waverley Station, the lighting of which we have undertaken, is one of the most important in the country. If we do that thoroughly, all the tourists that go south and go north will see it, and we shall thus get a good advertisement. To show you, too, that the North British Company are quite aware of whom they are dealing with, they only had sixteen arc lights last year, and they have now given us an order for double that number. We are carrying that order out with an efficient staff and proper instruments, so that the sort of slipshod way in which it was done before will not recur in the management of your board of directors. Having obtained that position at Waverley, I consider we have got the gate of Edinburgh.

Mr. Walker: Is the order for a term of years or for a series of years?

Mr. Dickson: We have made the bargain as well as we could for several years. Of course you cannot get the railway companies to do as you will. There, the same as here, they make a compact, and say, "We will see that satisfactorily carried out for a certain number of years first."

Mr. Walker: And they can continue or discontinue the light altogether, I suppose?

Mr. Dickson: I think we are all friends here; but there are numbers of competitors watching us in Scotland, and it would not be judicious to tell you all that I could tell you here. I think the directors are doing their very best, and we do not wish to say too much to benefit our critics in the north. In obtaining the lighting of the Waverley Station, with our powerful engine we have ability to light up Princes Street, and a good deal more. We have drafts and estimates for Inverness, and for Dundee and Arbroath Stations. We have estimates for Tay Bridge, and are going into them. If we can only sufficiently see our way to save ourselves from loss and get an advertisement for our centre, and from that centre light other places near, I think we can see our way to a good business. We were told by the previous speaker that we cannot compete with gas, but I say we shall soon be put in the same position as the gas companies. Take Princes Street or Cheapside and say to a gas company, "Will you light up this street, and tell us the cost?" For twenty lamps perhaps you will have to pay twenty-one shillings per 1,000 feet. Your next neighbour perhaps only pays a few shillings, but there it is inside the houses. When we get inside the houses I trust the electric light will be as successful as the most far-seeing people expect In regard to the Oriental Storage Company, it has been stated that they having the storage batteries, were in a position to do more than we have done. But they have to pay for it, and I cannot see that in the present initial stage of batteries it is right to rush in and buy up anything that can be got (hear, hear). We have reserved our opinion and our money and are ready to take advantage of the best storage battery we can get. We have the money and I hope the brains to make a bargain, and when once we get inside the houses, we shall be able to do a business. No one who has read the evidence given before the parliamentary committee can have the slightest doubt about that (hear). I may say in touching upon these storage batteries that we have been in treaty for a number of months past for the best one standing in the market, and which I understand comprehends all the five best patents known, and it is the same as the Storage Company have. I think we have done no harm whatever by the delay. As regards what was said about the noble chairman, I am sorry he is not present. He takes an earnest interest in our company's welfare, and there is no one who, as an amateur, knows more of electricity than he does. When he went to the House of Lords, on the day when the Electric Lighting Bill was amended, he went there thoroughly determined to have—what had never been attempted by any one else—those two objectionable clauses altered, No. 2 and No. 7; and I may say that, both to his personal position in the House of Lords, and to the influence he brought to bear on his colleagues there, there is in a great measure due the fact that we have seven years instead of five for licences, and twenty-one instead of fifteen for provisional orders. That will allow us to feel about and see what we are doing, so that when the twenty-one years are over we may not be called upon, as we should at the fifteen, to sell our articles as old metal. I hope when Parliament meets next Session the two clauses now reading in opposition to each other will be put right, thus showing us where we stand. I think, meanwhile, the Bill as we have it is a good one to go on with, and the fact that we have not gone on more rapidly already is to be attributed to our not having the Bill. We could not do it, and had better let our money be at the bank at interest (hear, hear). Now we have the ability to take up streets instead of going and hanging wires overhead, making the most extraordinary state of things everywhere. We have now a bill which I think will do us very well for the present, and I believe your directors have the interests of our shareholders at heart; and I take it there is no place for our business like Scotland, where we can get such cheap coal, and if we can only make a central station as I have explained, we can produce the light, I think, very much cheaper than it can be produced here. The item of coal is one of great

importance in regard to the working of the engines and the machinery at all the factories. With water power available at every castle in the North, every mill wheel at the end of the village, if we use our centres well and do not expect too much, we have, I think, a fair prospect of doing as good business as have most things which are brought before us.

In reply to a further question from Mr. Walker, in regard to the selling of concessions.

Mr. Dickson explained that there was no use in their acting differently from what they had. Broker after broker came asking for concessions, but to have granted them would simply have been to prostitute their position. The matter of the sale of concessions they had still before them.

Mr. Wm. Ladd said that although unaccustomed to speak in public, he felt he would like to say a few words to give them confidence in the property in which they had invested their momey. He was an old electrican, and one of the pioneers of the electric light, therefore he flattered himself that he knew something of the different machines and different systems at present in vogue. The Brush machine he believed, in considering all the other systems, was very far in advance of every other for large lighting, he meant for extensive districts. There was no machine that could send a current so far as the Brush machine. There was no other machine that could give them 40 lights in one circuit. There was no other machine to compare with it for economy; he said economy, and he meant it. If they wanted one or two lights there were other machines that would compare with it, but if they wanted to light streets, or houses, there was no other machine in existence that would take so many lights; and although the price of the machine might appear to be somewhat high, yet the price of the machine was far below any other when they came to lighting a town or a large number of streets. Forty lights from one machine meant two wires, or rather one wire, going through the whole of those 40 lights and back to the machine; whereas in other systems, what you require for large lighting, you require a machine for each lamp, and that meant a great expense—more than was apparent at first sight, because they needed separate wires for each light and back again. From those lights on the Embankment, for instance, he believed that the Brush system would have given a better light and a greater light for the cost of what it had cost them for wires. Scotland was a splendid district for the light because of the water power that could be utilised. What must tell somewhat against Scotland, however, was that the Scotch people were scarcely educated up to the advantages of the electric light, and they had to educate them as yet. What he was anxious to do was to light up Glasgow, or some large place like that. Put out all the lights in the streets, and let the Scotchmen see what this company had got. There was nothing said in the prospectus with regard to accumulators. The gentleman who spoke just now would seem to say that he had been imposed upon by the prospectus. The gentleman ought to have made himself acquainted with all the ins and outs of the company. If he did not understand it, he ought not to blame any one else. It was unfortunate for the directors that there was such a rush for shares in this company; it gave them a great deal of work and caused a great deal of dissatisfaction amongst the public. Not a single director, he might say, appropriated more than one hundred shares to himself, although some applied for five hundred. They reduced their number in consequence of the number applied for. He hoped they would go on and prosper; and he was glad they had not sold concessions. He did not say they would not sell concessions, but the reaction that had come upon electric light now was affecting this company in the price of its shares, which was always the case when there was a great cry for anything.

A Voice: They are worth 17s. 6d. now.

Another Shareholder asked if any one could take the Brush system away from this company. Was it certainly theirs?

Mr. Ladd: Most decidedly, so far as Scotland is concerned. Mr. Ladd added that there was one thing he had forgotten to mention, and that was with reference to accumulators. He was a director of the Electric Light and Power Company, which had the entire lighting of the United Kingdom, and he should do all in his power for the benefit of this company; and if it could be arranged satisfactorily he was sure he would do all in his power in the matter. The Brush machine was adapted for the storage batteries, because they could have a machine in one district and send a charge along the whole street, and charge the storage batteries for the lighting of the houses.

Another Shareholder: Are you in negotiation for the use of the Sellon-Volckmar accumulator? Are the vendors allowed to dispose of their 8,000 shares?

The Chairman: The same as in any other company.

The Shareholder: With regard to the shares I hold, I should like to say I applied for shares when there were none to be had, and I bought those which I hold, so that the remarks made by Mr. Ladd are not fair. I had the prospectus before me.

Mr. Dickson said there were many accumulators before them, and he must decline to answer the question. The board were considering their merits, and he thought the shareholders had better let the question alone.

In reply to another question the chairman said that applications for shares were so large that they were obliged to cut down every one.

Mr. Dickson added that all the Brush companies had joined a conference, meeting monthly, to discuss the interests of the Brush patents, and they had taken issue on certain points. They had agreed on many points, by which they had obtained considerable concessions, and they were an earnest of what was to come. They were watching in earnest upon these matters, and pulling together with a will, so as to keep themselves well in front of their opponents everywhere.

Mr. Walker, who remarked that he was doubly unfortunate, for he bought some of his shares at a premium of between £2 and £3, and they were now worth 17s. 6d., proposed a vote of thanks to the chairman for presiding and the satisfactory manner in which he had red the questions, which was seconded by Mr. Newton, and ceedings terminated.

THE ELECTRIC CARBON, STORAGE, AND APPARATUS MANUFACTURING COMPANY OF SCOTLAND (LIMITED).

On Wednesday last, under the presidency of Mr. W. P. Hope, of Leith, the chairman of the company, the statutory meeting of the shareholders of the above-named company was held at Cannon Street Hotel.

The notice convening the meeting having been read by the secretary, Mr. Ernest Terreneau,

The Chairman said: You have heard the notice convening the meeting. It pretty well explains the cause of this meeting. It is simply a statutory meeting, to fall in with the law of limited liability companies, and, finding myself in the chair in the absence of Mr. Ratcliff, I have to explain that we have got possession of the premises at Leith, and we have been busy getting the necessary tools placed in those premises, and are now partially manufacturing carbons, in the hope of being able to begin manufacturing dynamo lamps within a few weeks of this time. We have 171 shareholders upon our list, holding 28,117 shares. The applications for shares—this company coming out late, when the electric *furore* was at its height—were smaller than were anticipated, but were sufficient to warrant the directors in going forward to allotment, especially as they had an offer for the sale of the storage shares which form part of the property to be handed over to this company at a price which induced them to part with them at once. Having made arrangements of settlement of property satisfactory to themselves, and having capital available for any extension of business, the board thought it wise to go on to allotment, and go forward with small capital, watching the event of electricity, and watching the future of it, believing we have a great deal yet to learn, believing we have a great deal we don't know to-day that we shall know in a month or two hence. We have no expensive patents, and no sums of money due for any system; we are simply waiting with a well organised system to take advantage of the time when the best electric machine will be before the company, and then to go forward. So far as we have gone in the direction of carbons, we have succeeded in producing an article which is as good as any yet before the public. Our prospects are very assuring. We have proposals from the continent and from various parts of this country for the manufacture of plant, when we are in a position to take it up. The demand for electric appliances such as we aim at producing, which is a good yet cheap article, will, we believe, be very encouraging to the public. We are going in to encourage the public in cheap electric appliances, and I believe in a very short time we shall have quite as much work as we can do. Many of the companies which have come before the public lately have savoured more of the kind which the Stock Exchange have more interest in than the company I am speaking of. A Stock Exchange quotation we do not intend to move for, seeing that our capital is insufficient. Those who invested money in this company will, with a little patience, find that something better than stock which may be bought and sold at the prices of the day. Owing to the delay in placing our machinery we have to-day to point more to what we intend to do rather than to what we have done. I hope next time we meet you that we shall have something more tangible to lay before you. We have some of our carbons here (on the table), which are at the disposition of the shareholders.

Dr. Rosenthal: I should like to ask whether any orders have been received already.

The Chairman: I think I explained in my opening remarks that we are only now in a position to receive orders, in consequence of delay in fixing our machinery.

Dr. Rosenthal asked if, when the money had been paid to the vendors, whether there would be enough capital to carry on the manufacturing.

The Chairman: I am glad to be able to give you that information, although I did state it in what I said before. I said that the directors were satisfied with the arrangements they had made with the vendors to forego their payment for a while, that they now had enough capital to carry on business, and to meet any increase of work for the next twelve months. We have already promises of work for several companies when we are ready to supply them; not exactly their orders, but promises to supply them with what they may require.

No further questions being asked, Mr. J. D. Fraser proposed a vote of thanks to the chairman, which concluded the proceedings.

Telegrams for Egypt.—It is officially announced that the Eastern Telegraph Company has established cable communication with Port Said, and telegrams for that place can be accepted, but at the sender's risk only. The charges are 2s. a word.

Cables Repaired.—Notice is given that the cable of the Paris and New York Telegraph Company, and the cable between Rio Grande do Sul and Monte Video, are repaired.

Brush Midland Electric Light and Power Company, Limited.—Mr. James Whitehead (chairman) and Mr. Augustus A. Stenger have resigned their seats at the board of this company.

Quotations have been granted to the Australasian Electric Light, Power and Storage Company, shares; the British Insulite Company, Limited, shares; and Swan United Electric Light Company, shares.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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MILITARY TELEGRAPH STATIONS IN BALLOONS.

Now that the friendly relations between the interior of Egypt and the world have been suspended and diplomatic negotiations are supplemented by the more telling speeches of heavy ordnance, telegraphic communication with the extensive system of Egyptian land lines has naturally ceased. The formerly friendly mission of the telegraph will for the present be used for a more serious object, viz., that of war.

One of the first operations, two opposing armies have to perform, consists in strengthening their own positions and in ascertaining the strength and position of the adversary. This latter object is generally attained by reconnoitering expeditions and by skirmishing and sham attacks, trying either to reach an eminence from whence a better view of the enemy's position may be obtained, or to force the enemy to show his strength.

A less sanguinary and perhaps more efficient mode of ascertaining the enemy's position can be used, viz., captive balloons, connected with the ground by telegraph cables; the aeronaut is thus enabled to communicate his observations to headquarters immediately, not only during a reconnaissance, but also during action. It is to this kind of aerial telegraph station that we wish to draw attention at present.

Balloons were used for reconnoitering purposes as early as the year 1794, during the wars of the French Revolution, and with great success. Two companies of aeronauts were then organised by the French, who used war-balloons at Fleurs, Maubeuge, Charleroi, Mannheim, Ehrenbreitenstein, &c. These balloons were not employed as couriers, but for reconnoitering an enemy, and sometimes the flag-signal telegraph was used. Balloon ascents were also made for the purpose of observing an enemy's movements during a battle, and thus took part in the tactical operations of the engagement.

Colonel Coutelle observed and reported, in June, 1794, from a war-balloon station, the operations of the battle of Fleurs, and the French Academy of Science, convinced of the value of such stations for military reconnoitering, recommended the general introduction of balloons for war purposes. The result was that during the same year a military aeronautical school was created in Meudon under the able direction of the celebrated aeronaut, M. Guyton de Morveau and Colonel Coutelle.

Notwithstanding these attempts, war ballooning little occupied the minds of military men from the beginning of this century until 1859, during the Crimean War, when a balloon was again tried, unfortunately, however, without any valuable results being obtained for the military operations.

To North America is due the honour of having given this half-forgotten companion of modern warfare a practical and new application. We can do no better than quote here from Mr. W. Plum's valuable book "The Military Telegraph," just published in Chicago. Mr. Plum, who was an active and distinguished officer of the American Field Telegraph Corps, says: "War balloons were used in the United States army on the Potomac and during the Peninsular campaign. On all such reconnaissances the balloon was held by ropes, and on several occasions electrical telegraphic connection was kept up with the aeronaut in the sky. This was first accomplished June 17th, 1861, when the War Department, in Washington, was placed in instant communication with Prof. Lowe, who, from his 'high estate,' caused the operator at his side to telegraph to the President of the United States:—

"SIR,—The point of observation commands an area of 50 miles in diameter. The city, with its girdle of encampments, presents a superb scene. I take great pleasure in sending you the first despatch ever telegraphed (electrically) from an aerial station and in acknowledging my indebtedness to your encouragement for the opportunity of demonstrating the availability of the science of aeronautics in the military service of the country.

"Yours respectfully,
"(Signed), T. S. C. LOWE.

"Operator C. T. Brown ascended from Pohick Church, Virginia, with Prof. Wise, and also communicated to the War Department. John La Mountain, another professional aeronaut, made ascents accompanied by General Fitz John Porter . . . . ."

The history of the North American war supplies a series of most valuable facts where balloon telegraph stations took part in the tactical operations of military engagements, and not seldom considerably contributed to the development and final success of the battle. But not only this; the Americans also tried, and with tolerable success, to obtain photographic plans of the enemy's positions taken from their telegraph balloon stations. Thus the country between Richmond, Manchester, and Chikahoming, with its batteries and troops, was photographed.

At the battle of Richmond an outpost telegraph station, placed in a balloon, captive at a height of 300 yards, was in telegraphic communication with headquarters during the whole engagement. General McClellan received immediate information from the balloon of all movements of the enemy, and was thus enabled to issue timely and correct orders to his generals, Heinselmann and Summer, for a simultaneous attack of the enemy from various directions. It is generally acknowledged that the conquest of Richmond and the complete victory of the North army was considerably due to the valuable information received from the balloon outpost telegraph station.

The next balloon reconnaissance was carried out in June, 1867, during the Paraguayan war by Brazil, which country, by the way, claims the invention of the balloon for her countryman Don Guzman, who ascended in a balloon as early as 1736 in presence of John V., the King of Portugal. Mr. von Treuenfeld, who commanded the Paraguayan field telegraph corps, says, in his book on "War Telegraphy," that the Brazilian balloon reconnoitred the fortified positions at Tuyuti and Tuyucué from a height of 200 metres, being fastened to a cable and carried along the enemy's lines by soldiers. The ascents were accompanied by staff officers, who not only drew plans of the hitherto unknown fortific-

tions, but also counted the 106 guns and three mortars, which a few days later were to be attacked.

During the Franco-German war the French army obtained great assistance through the employment of war-balloons as couriers of military orders, news, &c. Suffice it to say that from September 23rd, 1870, to January 28th, 1871, sixty-two balloons left Paris, fifty-four of which, sent out by the Post-office Department, took 2,500,000 letters, weighing ten tons. Stationary balloons (ballons captifs) were used for reconnoitering purposes, fitted out as Morse telegraph stations, and were connected with the semi-permanent field lines and the headquarters of the commander. The first of these aerial French telegraph stations ascended on November 21st, 1870, at the camp of Gidy, and on December 7th, 1870, a military aeronautical troop was formed and incorporated into the French army, which carried five balloons, to the front of the Loire army. Other balloons operated with the East army at Besançon, and with the North army at Amiens.

It is to be regretted that the information obtained by the French reconnoitering balloon stations during the Franco-German war was not in proportion to the enormous efforts and patriotic devotion of the promoters and troop of the war-balloons. This is by no means an argument against the efficiency of either of them, but only a too natural consequence of want of time for proper organisation. The rapid march of military events during the Franco-German war made the thorough organisation of a balloon service impossible, which, had it been prepared in time of peace, would undoubtedly have been of great service to the French army.

The present intimate connection between French military aeronauts and the Académie d'Aérostation Météorologique sufficiently proves that the French army learned a lesson from their experiences of 1870.

In spite of many recommendations, since 1854, from Mr. Henry Coxwell, the venerable parent of English aeronautics, urging the introduction of balloon signalling stations for reconnoitering purposes into our army equipment, little was tried, and less adopted, for many years. The decision of the War Office was thus hailed with general satisfaction by the army when, in September, 1880, a whole company of the Royal Engineers were detailed for instruction in the art of war-ballooning. Seeing the service entrusted to such distinguished officers as Captain Elsdale, R.E., Lieutenants Nare, Noel, and Anstruther, all of the Royal Engineers, and Captain Templer, of the Royal Edmonton Rifle Militia, strong anticipations existed that the field-telegraph soldier of the C Division of Aldershot Royal Engineers would soon, in an airy balloon station, replace his skirmishing and exposed comrades on *terra firma*. Such anticipations were further strengthened by balloon drills performed by sappers, under the direction of Captain Elsdale and Captain Templer, before General Turner, General Philpott, Admiral Boyes, and other officers, demonstrating the high efficiency of the portable captive balloon with all its newly-invented gear of hydrogen generating apparatus, balloon car, engineers' transport waggon, &c. At a height of about 200 ft. the balloon was drawn about to illustrate the facility with which balloons can be transported to eligible points, and even telegraph lines and railway bridges were crossed with ease by the use of duplicate towing cables. Captain Elsdale, together with Corporal Joliffe and Corporal Thomson, carried on communication from the balloon by means of flag-signalling as well as by the telephone.

Still more promising were these experiments when the Secretary of State for War ordered balloons to be used during the manœuvres at the Brighton review. The ballooning party, consisting of two officers, nine non-commissioned officers and sappers, proceeded to Brighton with two balloons and all necessary equipments. The balloon "Crusader" was inflated and conveyed in safety across a difficult piece of ground to its position, occupied by the outposts of the Lewes force. The distance traversed being about two miles and a half, including the crossing of a tidal river, railway, and telegraph wires. Captain Norton, aide-de-camp, accompanied Captain Elsdale in the balloon, which was sent up about 1,100 ft. These officers were provided with maps of the ground on which it was proposed to make rough sketches of the enemy's positions for the information of the general officer commanding the Lewes forces. Captain Templer succeeded in moving the wagon below, with the balloon attached, at a very rapid pace through the intervals between the advancing battalions. Captain Elsdale reported that when the weather cleared a most excellent view of every man and movement below was obtained. When the troops were dismissed the waggon retired at a gallop, with balloon attached, and returned to Lewes without difficulty. Captain Elsdale thus sums up the valuable experience gained on that occasion: "I would respectfully submit for consideration that the following points would appear to have been established. A balloon, in fairly favourable weather, can be conveyed captive over any ground accessible to infantry to the required position for observation. It can be moved from time to time, as required in the course of the operations, to any other suitable point . . . . . and it seems probable that valuable observations might from time to time be made at all periods of the operations."

Taking all the historical facts together, which naturally are only mentioned here in an exceedingly condensed form, and returning to our subject, military reconnaissances in front of the newly-erected and unknown Egyptian fortifications, we are inclined to think, that a thorough review from a balloon telegraph station, at a height of 300 yards, would not only be a successful mode of reconnoitering, but also a highly interesting repetition of an experiment in scientific strategy, which had so often been successfully carried out at the balloon-drilling grounds and during the Brighton review.

THE BRITISH ASSOCIATION.

THE meeting of the present year, which was inaugurated on Wednesday, the 23rd inst., is the fifty-second assemblage of the members of the British Association. Southampton has before had the honour of being the selected centre to which the eminent men of science belonging to this association annually journey. Electrical science should naturally have a greater share of attention than in previous years, for its importance is almost daily becoming more and more apparent. The President of the year, Dr. C. W. Siemens, is one of our leading authorities on this subject, but he does not go far beyond a recapitulation of known facts in his address. He, however, makes several suggestions, and has covered a vast amount of ground. What he says we can accept as correct, for Dr. Siemens is not inclined

to indulge in speculative imagination. Professors Lord Rayleigh, G. D. Liveing, R. Etheridge, and A. Gamgee, preside over the respective sections of Mathematical and Physical Science (A), Chemical Science (B), Geology (C), and Biology (D).

Sections (E), Geography; (F), Economic Science and Statistics; and (G), Mechanical Science, have respectively as Presidents, Sir R. Temple, Bart., Right Hon. G. Sclater-Booth, M.P., and John Fowler, Esq., C.E. The General Treasurer of the Association is Professor A. W. Williamson, of University College, London; and the Secretary is Professor T. G. Bonney.

THE PRESIDENT'S ADDRESS.

In venturing to address the British Association from this chair, I feel that I have taken upon myself a task involving very serious responsibility. The Association has for half a century fulfilled the important mission of drawing together, once every year, scientists from all parts of the country for the purpose of discussing questions of mutual interest, and of cultivating those personal relations which aid so powerfully in harmonising views, and in stimulating concerted action for the advancement of science.

A sad event casts a shadow over our gathering. While still mourning the irreparable loss science had sustained in the person of Charles Darwin, whose bold conceptions, patient labour, and genial mind made him almost a type of unsurpassed excellence, telegraphic news reached Cambridge, just a month ago, to the effect that our honorary secretary, Professor F. M. Balfour, had lost his life during an attempted ascent of the Aiguille Blanche de Penteret. Although only thirty years of age, few men have won distinction so rapidly and so deservedly. After attending the lectures of Michael Foster, he completed his studies of Biology under Dr. Anton Dohrn at the Zoological Station of Naples in 1875. In 1878 he was elected a Fellow, and in November last a member of Council of the Royal Society, when he was also awarded one of the royal medals for his embryological researches. Within a short interval of time Glasgow University conferred on him their honorary degree of LL.D., he was elected President of the Cambridge Philosophical Society, and after having declined very tempting offers from the Universities of Oxford and Edinburgh, he accepted a professorship of Animal Morphology created for him by his own university. Few men could have borne without hurt such a stream of honourable distinctions; but in young Balfour genius and independence of thought were happily blended with industry and personal modesty; these won for him the friendship, esteem, and admiration of all who knew him.

Since the days of the first meeting of the Association in York in 1831, great changes have taken place in the means at our disposal for exchanging views, either personally or through the medium of type. The creation of the railway system has enabled congenial minds to attend frequent meetings of those special societies which have sprung into existence since the foundation of the British Association, amongst which I need only name here the Physical, Geographical, Meteorological, Anthropological, and Linnean, cultivating abstract science, and the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, the Society of Telegraph Engineers and of Electricians, the Gas Institute, the Sanitary Institute, and the Society of Chemical Industry, representing applied science. These meet at frequent intervals in London, whilst others, having similar objects in view, hold their meetings at the University towns, and at other centres of intelligence and industry throughout the country, giving evidence of great mental activity, and producing some of those very results which the founders of the British Association wished to see realised. If we consider further the extraordinary development of scientific journalism which has taken place, it cannot surprise us when we meet with expressions of opinion to the effect that the British Association has fulfilled its mission, and should now yield its place to those special societies it has served to call into existence. On the other hand, it may be urged that the brilliant success of last year's anniversary meeting, enhanced by the comprehensive address delivered on that occasion by my distinguished predecessor in office, Sir John Lubbock, has proved, at least, that the British Association is not dead in the affections of its members, and it behoves us at this, the first ordinary gathering in the second half century, to consider what are the strong points to rely upon for the continuance of a career of success and usefulness.

If the facilities brought home to our doors of acquiring scientific information have increased, the necessities for scientific inquiry have increased in a greater ratio. The time was when science was cultivated only by the few, who looked upon its application to the arts and manufactures as almost beneath their consideration; this they were content to leave in the hands of others, who, with only commercial aims in view, did not aspire to further the objects of science for its own sake, but thought only of benefiting by its teachings. Progress could not be rapid under this condition of things, because the man of pure science rarely pursued his inquiry beyond the mere enunciation of a physical or chemical principle, whilst the simple practitioner was at a loss how to harmonise the new knowledge with the stock of information which formed his mental capital in trade.

The advancement of the last fifty years has, I venture to submit, rendered theory and practice so inter-dependent that an intimate union between them is a matter of absolute necessity for our future progress. Take, for instance, the art of dyeing, and we find that the discovery of new colouring matters derived from waste products, such as coal-tar, completely changes its practice, and renders an intimate knowledge of the science of chemistry a matter of absolute necessity to the practitioner. In telegraphy and in the new arts of applying electricity to lighting, to the transmission of power, and to metallurgical operations, problems arise at every turn, requiring for their solution not only an intimate acquaintance with, but a positive advance upon, electrical science as established by purely theoretical research in the laboratory. In general engineering the mere practical art of constructing a machine so designed and proportioned as to produce mechanically the desired effect, would suffice no longer. Our increased knowledge of the nature of the mutual relations between the different forms of energy makes us see clearly what are the theoretical limits of effect; these, although beyond our absolute reach, may be looked upon as the asymptotes to be approached indefinitely by the hyperbolic course of practical progress, of which we should never lose sight. Cases arise, moreover, where the introduction of new materials of construction, or the call for new effects, renders former rules wholly insufficient. In all these cases practical knowledge has to go hand in hand with advanced science in order to accomplish the desired end.

Far be it from me to think lightly of the ardent students of nature, who, in their devotion to research, do not allow their minds to travel into the regions of utilitarianism and of self-interest. These, the high priests of science, command our utmost admiration; but it is not to them that we can look for our current progress in practical science, much less can we look for it to the "rule of thumb" practitioner, who is guided by what comes nearer to instinct than to reason. It is to the man of science, who also gives attention to practical questions, and to the practitioner, who devotes part of his time to the prosecution of strictly scientific investigations, that we owe the rapid progress of the present day, both merging more and more into one class, that of pioneers in the domain of nature. It is such men that Archimedes must have desired when he refused to teach his disciples the art of constructing his powerful ballistic engines, exhorting them to give their attention to the principles involved in their construction, and that Telford, the founder of the Institution of Civil Engineers, must have had in his mind's eye when he defined civil engineering as "the art of directing the great sources of power in nature."

These considerations may serve to show that although we see the men of both abstract and applied science group themselves in minor bodies for the better prosecution of special objects, the points of contact between the different branches of knowledge are ever multiplying, all tending to form part of a mighty tree—the tree of modern science—under whose ample shadow its cultivators will find it both profitable and pleasant to meet, at least once a year; and considering that this tree is not the growth of one country only, but spreads both its roots and branches far and wide, it appears desirable that at these yearly gatherings other nations should be more fully represented than has hitherto been the case. The subjects discussed at our meetings are without exception of general interest, but many of them bear an international character, such as the systematic collection of magnetic, astronomical, meteorological, and geodetical observations, the formation of a universal code for signalling at sea, and for distinguishing lighthouses, and especially the settlement of scientific nomenclatures and units of measurement, regarding all of which an international accord is a matter of the utmost practical importance.

As regards the measures of length and weight it is to be regretted that this country still stands aloof from the movement initiated in France towards the close of last century; but, considering that in scientific work metrical measure is now almost universally adopted, and that its use has been already legalised in this country, I venture to hope that its universal adoption for commercial purposes will soon follow as a matter of course. The practical advantages of such a measure to the trade of this country would, I am convinced, be very great, for English goods, such as machinery or metal rolled to current sections, are now almost excluded from the continental market, owing to the unit measure employed in their production. The principal impediment to the adoption of the metre consists in the strange anomaly that although it is legal to use that measure in commerce, and although a copy of the standard metre is kept in the Standards' Department of the Board of Trade, it is impossible to procure legalised rods representing it, and to use a non-legalised copy of a standard in commerce is deemed fraudulent. Would it not be desirable that the British Association should endeavour to bring about the use in this country of the metre and kilogramme, and as a preliminary step, petition the Government to be represented on the International Metrical Commission, whose admirable establishment at Sèvres possesses, independently of its practical work, considerable scientific interest as a well-found laboratory for developing methods of precise measurement?

Next in importance to accurate measures of length, weight, and time, stand, for the purposes of modern science, those of electricity.

The remarkably clear lines separating conductors from non-conductors of electricity, and magnetic from non-magnetic substances, enable us to measure electrical quantites and effects with almost mathematical precision; and although the ultimate nature of this, the youngest scientifically investigated form of energy, is yet wrapt in mystery, its laws are the most clearly established, and its measuring instruments (galvanometers, electrometers, and magnetometers), are amongst the most accurate in physical science. Nor could any branch of science or industry be named in which electrical phenomena do not occur, to exercise their direct and important influence.

If, then, electricity stands foremost amongst the exact sciences, it follows that its unit measures should be determined with the utmost accuracy. Yet, twenty years ago, very little advance had been made towards the adoption of a rational system. Ohm had, it is true, given us the fixed relations existing between electromotive force, resistance and quantity of current; Joule had established the dynamical equivalent of heat and electricity, and Gauss and Weber had proposed their elaborate system of absolute magnetic measurement. But these invaluable researches appeared only as isolated efforts, when, in 1862, the Electric Unit Committee was appointed by the British Association, at the instance of Sir William Thomson,

and it is to the long-continued activity of this Committee that the world is indebted for a consistent and practical system of measurement, which, after being modified in details, received universal sanction last year by the International Electrical Congress assembled at Paris.

At this Congress, which was attended officially by the leading physicists of all civilised countries, the attempt was successfully made to bring about a union between the statical system of measurement that had been followed in Germany and some other countries, and the magnetic or dynamical system developed by the British Association, also between the geometrical measure of resistance, the (Werner) Siemens unit, that had been generally adopted abroad, and the British Association unit intended as a multiple of Weber's absolute unit, though not entirely fulfilling that condition. The Congress, while adopting the absolute system of the British Association, referred the final determination of the unit measure of resistance to an International Committee, to be appointed by the representatives of the several Governments; they decided to retain the mercury standard for reproduction and comparison, by which means the advantages of both systems are happily combined, and much valuable labour is utilised; only, instead of expressing electrical quantities directly in absolute measure, the Congress has embodied a consistent system, based on the ohm, in which the units are of a value convenient for practical measurements. In this, which we must hereafter know as the "practical system," as distinguished from the "absolute system," the units are named after leading physicists, the Ohm, Ampère, Volt, Coulomb, and Farad.

I would venture to suggest that two further units might, with advantage, be added to the system decided on by the International Congress at Paris. The first of these is the unit of magnetic quantity or pole. It is of much importance, and few will regard otherwise than with satisfaction the suggestion of Clausius that the unit should be called a "Weber," thus retaining a name most closely connected with electrical measurements, and only omitted by the Congress in order to avoid the risk of confusion in the magnitude of the unit current with which his name had been formerly associated.

The other unit I should suggest adding to the list is that of power. The power conveyed by a current of an Ampère through the difference of potential of a Volt is the unit consistent with the practical system. It might be appropriately called a Watt, in honour of that master mind in mechanical science James Watt. He it was who first had a clear physical conception of power, and gave a rational method of measuring it. A Watt, then, expresses the rate of an Ampère multiplied by a Volt, whilst a horse-power is 746 Watts, and a Cheval de Vapeur 735.

The system of electro-magnetic units would then be:—

(1) Weber,	the unit of	magnetic quantity	$= 10^8$	C.G.S. Units.
(2) Ohm	,,	,, resistance	$= 10^9$	,,
(3) Volt	,,	,, electromotive force	$= 10^8$	,,
(4) Ampère	,,	,, current	$= 10^{-1}$	,,
(5) Coulomb	,,	,, quantity	$= 10^{-1}$	,,
(6) Watt	,,	,, power	$= 10^7$	,,
(7) Farad	,,	,, capacity	$= 10^{-9}$	,,

Before the list can be looked upon as complete two other units may have to be added, the one expressing that of magnetic field, and the other of heat in terms of the electromagnetic system. Sir William Thomson suggested the former at the Paris Congress, and pointed out that it would be proper to attach to it the name of Gauss, who first theoretically and practically reduced observations of terrestrial magnetism to absolute measure. A Gauss will, then, be defined as the intensity of field produced by a Weber at a distance of one centimetre; and the Weber will be the absolute C.G.S. unit strength of magnetic pole. Thus the mutual force between two ideal point-poles, each of one Weber strength held at unit distance asunder, will be one dyne; that is to say, the force which acting for a second of time on a gramme of matter, generates a velocity of one centimetre per second.

The unit of heat has hitherto been taken variously as the heat required to raise a pound of water at the freezing-point through 1° Fahrenheit or Centigrade, or, again, the heat necessary to raise a kilogramme of water 1° Centigrade. The inconvenience of a unit so entirely arbitrary is sufficiently apparent to justify the introduction of one based on the electromagnetic system, viz., the heat generated in one second by the current of an Ampère flowing through the resistance of an Ohm. In absolute measure its value is 10^7 C.G.S. units, and assuming Joule's equivalent as 42,000,000, it is the heat necessary to raise 0·238 grammes of water 1° Centigrade, or, approximately, the 1-1000th part of the arbitrary unit of a pound of water raised 1° Fahrenheit and the 1-4000th of the kilogramme of water raised 1° Centigrade. Such a heat unit, if found acceptable, might with great propriety, I think, be called the Joule, after the man who has done so much to develop the dynamical theory of heat.

Professor Clausius urges the advantages of the statical system of measurement for simplicity, and shows that the numerical values of the two systems can readily be compared by the introduction of a factor, which he proposes to call the critical velocity; this, Weber has already shown to be nearly the same as the velocity of light. It is not immediately evident how by the introduction of a simple multiple, signifying a velocity, the statical can be changed into dynamical values, and I am indebted to my friend Sir William Thomson for an illustration which struck me as remarkably happy and convincing. Imagine a ball of conducting matter so constituted that it can at pleasure be caused to shrink. Now let it first be electrified and left insulated with any quantity of electricity on it. After that, let it be connected with the earth by an excessively fine wire, or a not perfectly dry silk fibre; and let it shrink just so rapidly as to keep its potential constant, till the whole charge is carried off. The velocity with which its surface approaches its centre is the electrostatic measure of the conducting power of the fibre. Thus we see how "conducting power" is, in electrostatic theory, properly measured in terms of a velocity. Weber had shown how, in electromagnetic theory, the resistance, or the reciprocal of the conducting power of a conductor, is properly measured by a velocity. The critical velocity, which measures the conducting power in electrostatic reckoning and the resistance in electromagnetic, of one and the same conductor, measures the number of electrostatic units in the electromagnetic unit of electric quantity.

Without waiting for the assembling of the International Committee charged with the final determination of the Ohm, one of its most distinguished members, Lord Rayleigh, has, with his collaborateure, Mrs. Sidgwick, continued his important investigation in this direction at the Cavendish Laboratory, and has lately placed before the Royal Society a result which will probably not be surpassed in accuracy. His redetermination brings him into close accord with Dr. Werner Siemens, their two values of the mercury unit being 0·95418 and 0·9536 of the B.A. unit respectively, or 1 mercury unit $= 0{\cdot}9413 \times 10^9$ C.G.S. units.

Shortly after the publication of Lord Rayleigh's recent results, Messrs. Glazebrook, Dodds, and Sargant, of Cambridge communicated to the Royal Society two determinations of the Ohm, by different methods; and it is satisfactory to find that their final values differ only in the fourth decimal, the figures being, according to

Lord Rayleigh .. .. 1 Ohm $= 0{\cdot}98651 \dfrac{\text{Earth Quadrant}}{\text{Second}}$

Messrs. Glazebrook, &c. .. $= 0{\cdot}986439$,,

Professor E. Wiedemann, of Leipzig, has lately called attention to the importance of having the Ohm determined in the most accurate manner possible, and enumerates four distinct methods, all of which should unquestionably be tried with a view of obtaining concordant results, because upon its accuracy will depend the whole future system of measurement of energy of whatever form.

The word Energy was first used by Young in a scientific sense, and represents a conception of recent date, being the outcome of the labours of Carnot, Mayer, Joule, Grove, Clausius, Clerk-Maxwell, Thomson, Stokes, Helmholtz, Macquorn-Rankine, and other labourers, who have accomplished for the science regarding the forces in Nature what we owe to Lavoisier, Dalton, Berzelius, Liebig, and others, as regards chemistry. In this short word Energy we find all the efforts in nature, including electricity, heat, light, chemical action, and dynamics, equally represented, forming, to use Dr. Tyndall's apt expression, so many 'modes of motion.' It will readily be conceived that when we have established a fixed numerical relation between these different modes of motion, we know beforehand what is the utmost result we can possibly attain in converting one form of energy into another, and to what extent our apparatus for effecting the conversion falls short of realising it. The difference between ultimate theoretical effect and that actually obtained is commonly called loss, but, considering that energy is indestructible, represents really secondary effect, which we obtain without desiring it. Thus friction in the working parts of a machine represents a loss of mechanical effect, but is a gain of heat, and in like manner the loss sustained in transferring electrical energy from one point to another is accounted for by heat generated in the conductor. It sometimes suits our purpose to augment the transformation of electrical into heat energy at certain points of the circuit, when the heat rays become visible, and we have the incandescence electric light. In effecting a complete severance of the conductor for a short distance, after the current has been established, a very great local resistance is occasioned, giving rise to the electric arc, the highest development of heat ever attained. Vibration is another form of lost energy in mechanism, but who would call it a loss if it proceeded from the violin of a Joachim or a Norman-Neruda?

Electricity is the form of energy best suited for transmitting an effect from one place to another; the electric current passes through certain substances—the metals—with a velocity limited only by the retarding influence caused by electric charge of the surrounding dielectric, but approaching probably under favourable conditions that of radiant heat and light, or 300,000 kilometres per second; it refuses, however, to pass through oxidised substances, glass, gums, or through gases, except when in a highly rarefied condition. It is easy therefore to confine the electric current within bounds, and to direct it through narrow channels of extraordinary length. The conducting wire of an Atlantic cable is such a narrow channel; it consists of a copper wire, or strand of wires, 5 mm. in diameter, by nearly 5,000 kilometres in length, confined electrically by a coating of gutta-percha about 4 mm. in thickness. The electricity from a small galvanic battery passing into this channel prefers the long journey to America in the good conductor, and back through the earth, to the shorter journey across the 4 mm. in thickness of insulating material. By an improved arrangement the alternating currents employed to work long submarine cables do not actually complete the circuit, but are merged in a condenser at the receiving station, after having produced their extremely slight but certain effect upon the receiving instrument. So perfect is the channel and so precise the action of both the transmitting and receiving instruments employed, that two systems of electric signals may be passed simultaneously through the same cable in opposite directions, producing independent records at either end. By the application of this duplex mode of working to the Direct United States cable, under the superintendence of Dr. Muirhead, its transmitting power was increased from 25 to 60 words a minute, being equivalent to about twelve currents or primary impulses per second. In transmitting these impulse-currents simultaneously from both ends of the line, it must not be imagined, however, that they pass each other in the manner of liquid waves belonging to separate systems; such a supposition would involve momentum in the electric flow, and although the effect produced is analogous to such an action, it rests upon totally different grounds—namely, that of a local circuit at

each terminus being called into action automatically whenever two similar currents are passed into the line simultaneously from both ends. In extending this principle of action quadruplex telegraphy has been rendered possible, although not yet for long submarine lines.

The minute currents here employed are far surpassed as regards delicacy and frequency by those revealed to us by that marvel of the present day, the telephone. The electric currents caused by the vibrations of a diaphragm acted upon by the human voice, naturally vary in frequency and intensity according to the number and degree of those vibrations, and each motor current in exciting the electro-magnet forming part of the receiving instrument, deflects the iron diaphragm occupying the position of an armature to a greater or smaller extent according to its strength. Savart found that the fundamental *la* springs from 440 complete vibrations in a second, but what must be the frequency and modulations of the motor current and of magnetic variations necessary to convey to the ear through the medium of a vibrating armature such a complex of human voices and of musical instruments as constitutes an opera performance? And yet such performances could be distinctly heard and even enjoyed as an artistic treat by applying to the ears a pair of the double telephonic receivers at the Paris Electrical Exhibition, when connected with a pair of transmitting instruments in front of the footlights of the Grand Opera. In connection with the telephone, and with its equally remarkable adjunct the microphone, the names of Reis, Graham Bell, Edison, and Hughes will ever be remembered.

Considering the extreme delicacy of the currents working a telephone, it is obvious that those caused by induction from neighbouring telegraphic line wires would seriously interfere with the former and mar the speech or other sounds produced through their action. To avoid such interference the telephone wires if suspended in the air require to be placed at some distance from telegraphic line wires, and to be supported by separate posts. Another way of neutralising inteference consists in twisting two separately insulated telephone wires together, so as to form a strand, and in using the two conductors as a metallic circuit to the exclusion of the earth; the working current will, in that case, receive equal and opposite inductive influences, and will therefore remain unaffected by them. On the other hand two insulated wires instead of one are required for working one set of instruments; and a serious increase in the cost of installation is thus caused. To avoid this Mr. Jacob has lately suggested a plan of combining pairs of such metallic circuits again into separate working pairs, and these again with other working pairs, whereby the total number of telephones capable of being worked without interference is made to equal the total number of single wires employed. The working of telephones and telegraphs in metallic circuit has the further advantage that mutual volta induction between the outgoing and returning currents favours the transit, and neutralises on the other hand the retarding influence caused by charge in underground or submarine conductors. These conditions are particularly favourable to underground line wires, which possess other important advantages over the still prevailing overground system, in that they are unaffected by atmospheric electricity, or by snowstorm and heavy gales, which at not very rare intervals of time put us back to pretelegraphic days, when the letter-carrier was our swiftest messenger.

The underground system of telegraphs, first introduced into Germany by Werner Siemens in the years 1847-8, had to yield for a time to the overground system owing to technical difficulties, but it has been again resorted to within the last four years, and multiple land cables of solid construction now connect all the important towns of that country. The first cost of such a system is no doubt considerable (being about £38 per kilometre of conductor as against £8 10s. the cost of land lines); but as the underground wires are exempt from frequent repairs and renewals, and as they insure continuity of service, they are decidedly the cheaper and better in the end. The experience afforded by the early induction of the underground system in Germany was not, however, without its beneficial results, as it brought to light the phenomena of lateral induction, and of faults in the insulating coating, matters which had to be understood before submarine telegraphy could be attempted with any reasonable prospect of success.

Regarding the transmission of power to a distance the electric current has now entered the lists in competition with compressed air, the hydraulic accumulator, and the quick running rope as used at Schaffhausen to utilise the power of the Rhine fall. The transformation of electrical into mechanical energy can be accomplished with no further loss than is due to such incidental causes as friction and the heating of wires; these in a properly designed dynamo-electric machine do not exceed ten per cent., as shown by Dr. John Hopkinson, and, judging from recent experiments of my own, a still nearer approach to ultimate perfection is attainable. Adhering, however, to Dr. Hopkinson's determination for safety's sake, and assuming the same percentage in reconverting the current into mechanical effect, a total loss of 19 per cent. results. To this loss must be added that through electrical resistance in the connecting line wires, which depends upon their length and conductivity, and that due to heating by friction of the working parts of the machine. Taking these as being equal to the internal losses incurred in the double process of conversion, there remains a useful effect of $100 - 38 = 62$ per cent., attainable at a distance, which agrees with experimental results, although in actual practice it would not be safe at present to expect more than 50 per cent. of ultimate useful effect, to allow for all mechanical losses.

In using compressed air or water for the transmission of power the loss cannot be taken at less than 50 per cent., and as it depends upon fluid resistance it increases with distance more rapidly than in the case of electricity. Taking the loss of effect in all cases as 50 per cent., electric transmission presents the advantage that an insulated wire does the work of a pipe capable of withstanding high internal pressure, which latter must be more costly to put down and to maintain. A second metallic conductor is required, however, to complete the electrical circuit, as the conducting power of the earth alone is found unreliable for passing quantity currents, owing to the effects of polarisation; but as this second conductor need not be insulated, water or gas pipes, railway metals or fencing wire, may be called into requisition for the purpose. The small space occupied by the electro-motor, its high working speed, and the absence of waste products, render it specially available for the general distribution of power to cranes and light machinery of every description. A loss of effect of 50 per cent. does not stand in the way of such applications, for it must be remembered that a powerful central engine of best construction produces motive power with a consumption of two pounds of coal per horse-power per hour, whereas small engines distributed over a district would consume not less than five; we thus see that there is an advantage in favour of electric transmission as regards fuel, independently of the saving of labour and other collateral benefits.

To agriculture, electric transmission of power seems well adapted for effecting the various operations of the farm and fields from one centre. Having worked such a system myself in combination with electric lighting and horticulture for upwards of two years, I can speak with confidence of its economy, and of the facility with which the work is accomplished in charge of untrained persons.

As regards the effect of the electric light upon vegetation, there is little to add to what was stated in my paper read before Section A last year, and ordered to be printed with the report, except that in experimenting upon wheat, barley, oats, and other cereals sown in the open air, there was a marked difference between the growth of the plants influenced and those uninfluenced by the electric light. This was not very apparent till towards the end of February, when, with the first appearance of mild weather, the plants under the influence of an electric lamp of 4,000 candle-power placed about 5 metres above the surface, devolved with extreme rapidity, so that by the end of May they stood above four feet high, with the ears in full bloom, when those not under its influence were under two feet in height, and showed no sign of the ear.

In the electric railway first constructed by Dr. Werner Siemens, at Berlin, in 1879, electric energy was transmitted to the moving carriage or train of carriages through the two rails upon which it moved, these being sufficiently insulated from each other by being placed upon well creosoted cross sleepers. At the Paris Electrical Exhibition the current was conveyed through two separate conductors making sliding or rolling contact with the carriage, whereas in the electric railway now in course of construction in the north of Ireland (which when completed will have a length of twelve miles), a separate conductor will be provided by the side of the railway, and the return circuit completed through the rails themselves, which in that case need not be insulated; secondary batteries will be used to store the surplus energy created in running downhill, to be restored in ascending steep inclines, and for passing roadways where the separate insulated conductor is not practicable. The electric railway possesses great advantages over horse or steam-power for towns, in tunnels, and in all cases where natural sources of energy, such as waterfalls, are available; but it would not be reasonable to suppose that it will in its present condition compete with steam propulsion upon ordinary railways. The transmission of power by means of electric conductors possesses the further advantage over other means of transmission that, provided the resistance of the rails be not very great, the power communicated to the locomotive reaches its maximum when the motion is at its minimum—that is, in commencing to work, or when encountering an exceptional resistance—whereas the utmost economy is produced in the normal condition of working when the velocity of the power-absorbing nearly equals that of the current-producing machine.

The deposition of metals from their solutions is perhaps the oldest of all useful applications of the electric current, but is only in very recent times that the dynamo current has been practically applied to the refining of copper and other metals, as now practised at Birmingham and elsewhere, and upon an exceptionally large scale at Ocker, in Germany. The dynamo machine there employed was exhibited at the Paris Electrical Exhibition, its peculiar feature being that the conductors upon the rotating armature consisted of solid bars of copper, 30 mm. square, in section, which were found only just sufficient to transmit the large quantity of electricity of low ten .on necessary for this operation. One such machine consuming 4 horse-power deposits about 300 kilogrammes of copper per 24 hours, the motive power at Ocker is derived from a waterfall.

Electric energy may also be employed for heating purposes, but in this case it would obviously be impossible for it to compete in point of economy with the direct combustion of fuel for the attainment of ordinary degrees of heat. Bunsen and St. Claire De Ville have taught us, however, that combustion becomes extremely sluggish when a temperature of 1,800° C. has been reached, and for effects at temperatures exceeding that limit the electric furnace will probably find advantageous applications. Its specific advantage consists in being apparently unlimited in the degree of heat attainable, thus opening out a new field of investigation to the chemist and metallurgist. Tungsten has been melted in such a furnace, and 8 pounds of platinum have been reduced from the cold to the liquid condition in 20 minutes.

The largest and most extensive application of electric energy at the present time is to lighting, but considering how much has of late been said and written for and against this new illuminant, I shall here confine myself to a few general remarks. Joule has shown that if an electric current is passed through a conductor the whole of the energy lost by the current is converted into heat; or, if the resistance be localised, into radiant energy comprising heat, light, and actinic rays. Neither the low heat rays nor the ultra-violet of highest refrangibility affect the retina, and may be regarded as lost energy, the effective rays being those between the red and violet of the spectrum, which in their combination produce the effect of white light.

Regarding the proportion of luminous to non-luminous rays proceeding from an electric arc or incandescent wire, we have a mo-

valuable investigation by Dr. Tyndall, recorded in his work on "Radiant Heat." Dr. Tyndall shows that the luminous rays from a platinum wire heated to its highest point of incandescence, which may be taken at 1,700° C., formed 1-24th part of the total radiant energy emitted, and 1-10th part in the case of an arc light worked by a battery of 50 Grove's elements. In order to apply these valuable data to the case of electric lighting by means of dynamo-currents, it is necessary in the first place to determine what is the power of 50 Grove's elements of the size used by Dr. Tyndall, expressed in the practical scale of units as now established. From a few experiments lately undertaken for myself, it would appear that 50 such cells have an electromotive force of 98·5 Volts, and an internal resistance of 13·5 Ohms, giving a current of 7·3 Ampères when the cells are short-circuited. The resistance of a regulator such as Dr. Tyndall used in his experiments may be taken at 10 ohms, the current produced in the arc would be $\frac{98 \cdot 5}{13 \cdot 5 + 10 + 1} = 4$ Ampères (allowing one Ohm for the leads), and the power consumed $10 \times 4^2 = 160$ Watts; the light power of such an arc would be about 150 candles, and comparing this with an arc of 3,308 candles produced by 1,162 Watts, we find that $\left(\frac{1,162}{160}\right)$, *i.e.*, 7·3 times the electric energy produce $\left(\frac{3,308}{150}\right)$, *i.e.*, twenty-two times the amount of light measured horizontally. If, therefore, in Dr. Tyndall's arc 1-10th of the radiant energy emitted was visible as light, it follows that in a powerful arc of 3,300 candles, $\frac{1}{10} \times \frac{22 \cdot 0}{7 \cdot 3}$ or fully $\frac{1}{3}$, are luminous rays. In the case of the incandescence light (say a Swan light of 20 candle-power) we find in practice that nine times as much power has to be expended as in the case of the arc light; hence, $\frac{1}{3} \times \frac{1}{9} = $ 1-27 part of the power is given out as luminous rays, as against 1-24th in Dr. Tyndall's incandescent platinum—a result sufficiently approximate considering the wide difference of conditions under which the two are compared.

These results are not only of obvious practical value, but they seem to establish a fixed relation between current, temperature, and light produced, which may serve as a means to determine temperatures exceeding the melting point of platinum with greater accuracy than has hitherto been possible by actinimetric methods in which the thickness of the luminous atmosphere must necessarily exercise a disturbing influence. It is probably owing to this circumstance that the temperature of the electric arc as well as that of the solar photosphere has frequently been greatly over-estimated.

The principal argument in favour of the electric light is furnished by its immunity from products of combustion which not only heat the lighted apartments, but substitute carbonic acid and deleterious sulphur compounds for the oxygen upon which respiration depends; the electric light is white instead of yellow, and thus enables us to see pictures, furniture, and flowers as by daylight; it supports growing plants instead of poisoning them, and by its means we can carry on photography and many other industries at night as well as during the day. The objection frequently urged against the electric light, that it depends upon the continuous motion of steam or gas engines, which are liable to accidental stoppage, has been removed by the introduction into practical use of the secondary battery; this, although not embodying a new conception, has lately been greatly improved in power and constancy by Planté, Faure, Volckmar, Sellon, and others, and promises to accomplish for electricity what the gas-holder has done for the supply of gas and the accumulator for hydraulic transmission of power.

It can no longer be a matter of reasonable doubt, therefore, that electric lighting will take its place as a public illuminant, and that even though its cost should be found greater than that of gas, it will be preferred for the lighting of drawing-rooms and dining-rooms, theatres and concert-rooms, museums, churches, warehouses, show-rooms, printing establishments, and factories, and also the cabins and engine-rooms of passenger steamers. In the cheaper and more powerful form of the arc light, it has proved itself superior to any other illuminant for spreading artificial daylight over the large areas of harbours, railway stations, and the sites of public works. When placed within a holophote the electric lamp has already become a powerful auxiliary in effecting military operations both by sea and land.

The electric light may be worked by natural sources of power such as waterfalls, the tidal wave, or the wind, and it is conceivable that these may be utilised at considerable distances by means of metallic conductors. Some five years ago I called attention to the vastness of those sources of energy, and the facility offered by electrical conduction in rendering them available for lighting and power supply, while Sir William Thomson made this important matter the subject of his admirable address to Section A last year at York, and dealt with it in an exhaustive manner.

The advantages of the electric light and of the distribution of power by electricity have lately been recognised by the British Government, who have just passed a Bill through Parliament to facilitate the establishment of electrical conductors in towns, subject to certain regulating clauses to protect the interests of the public and of local authorities. Assuming the cost of electric light to be practically the same as gas, the preference for one or other will in each application be decided upon grounds of relative convenience, but I venture to think that gas-lighting will hold its own as the poor man's friend.

Dr. Siemens next dealt with the question of gas, giving it as his opinion that the time was not far distant when we should all resort to gas as a heating agent on the grounds [of co]nvenience, cleanliness, and economy. He said that the quasi-monopoly so long enjoyed by gas companies has had the inevitable effect of checking progress. They seemingly gave merely the prescribed illuminating power, discouraged the invention of economical burners, and the application of gas for heating purposes was partially discountenanced. The introduction of the electric light had, however, convinced gas managers that such a policy is no longer tenable.

The President then spoke of the coal-tar industry and the discovery of the aniline dyes, and he also alluded to the importance of ammonia as a manure, for the supply of which we have to look almost exclusively to our gas-works. In speaking of the use—or rather abuse—of using raw coal for heating purposes, he stated that Professor Roberts has calculated that the soot in the pall hanging over London on a winter's day amounts to 50 tons, and that the poisonous carbonic oxide may be taken as at least five times that amount. Mr. Aitken had shown that the fine dust resulting from the imperfect combustion of coal is mainly instrumental in the formation of fog. In commenting upon the luminosity of gas, the lecturer went on to say :—

The amount of light given out by a gas flame depends upon the temperature to which the particles of solid carbon in the flame are raised, and Dr. Tyndall has shown that of the radiant energy set up in such a flame only the 1-25th part is luminous; the hot products of combustion carry off at least four times as much energy as is radiated, so that not more than one hundredth part of the heat evolved in combustion is converted into light. This proportion could be improved, however, by increasing the temperature of combustion, which may be effected either by intensified air currents or by regenerative action. Supposing that the heat of the products of combustion could be communicated to metallic surfaces, and be transferred by conduction or otherwise to the atmospheric air supporting combustion in the flame, we should be able to increase the temperature accumulatively to any point within the limit of dissociation; this limit may be fixed at about 2,300° C., and cannot be very much below that of the electric arc. At such a temperature the proportion of luminous rays to the total heat produced in combustion would be more than doubled, and the brilliancy of the light would at the same time be greatly increased. Thus improved, gas-lighting may continue its rivalry with electric lighting both as regards economy and brilliancy, and such rivalry must necessarily result in great public advantage.

In the production of mechanical effect from heat, gaseous fuel also presents most striking advantages, as will appear from the following consideration. When we have to deal with the question of converting mechanical into electrical effect, or *vice versa*, by means of the dynamo-electrical machine, we have only to consider what are the equivalent values of the two forms of energy, and what precautions are necessary to avoid losses by the electrical resistance of conductors and by friction. The transformation of mechanical effect into heat involves no losses except those resulting from imperfect installation, and these may be so completely avoided that Dr. Joule was able by this method to determine the equivalent values of the two forms of energy. But in attempting the inverse operation of effecting the conversion of heat into mechanical energy, we find ourselves confronted by the second law of thermo-dynamics, which says that whenever a given amount of heat is converted into mechanical effect, another but variable amount descends from a higher to a lower potential, and is thus rendered unavailable.

In the condensing steam engine this waste heat comprises that communicated to the condensing water, whilst the useful heat, or that converted into mechanical effect, depends upon the difference of temperature between the boiler and condenser. The boiler pressure is limited, however, by considerations of safety and convenience of construction, and the range of working temperature rarely exceeds 120° C. except in the engines constructed by Mr. Perkins, in which a range of 160° C., or an expansive action commencing at 14 atmospheres, has been adopted with considerable promise of success, as appears from an able report on this engine by Sir Frederick Bramwell. To obtain more advantageous primary conditions we have to turn to the caloric or gas engine, because in them the co-efficient of efficiency expressed by $\frac{T - T'}{T}$ may be greatly increased. This value would reach a maximum if the initial absolute temperature T could be raised to that of combustion, and T′ reduced to atmospheric temperature, and these maximum limits can be much more nearly approached in the gas engine worked by a combustible mixture of air and hydrocarbons than in the steam engine.

Assuming, then, in an explosive gas engine a temperature of 1,500° C. at a pressure of 4 atmospheres, we should, in accord[ance with] the second law of thermo-dynamics, find a temperature aft[er expan]sion to atmospheric pressure of 600° C., and therefore a work[ing range] of $1500° - 600° = 900°$, and a theoretical efficiency of [...] = about one-half, contrasting very favourably with [...] expansive condensing steam engine, in which the rang[e ...] 120° C., and the efficiency $\frac{120}{150 + 274} = \frac{2}{7}$. A good [...] engine is therefore capable of yielding as mechan[ical ...] of the heat communicated to the boiler, which [...] heat lost by imperfect combustion, and that [...]

chimney. Adding to these the losses by friction and radiation in the engine, we find that the best steam engine yet constructed does not yield in mechanical effect more than 1-7th part of the heat energy residing in the fuel consumed. In the gas engine we have also to make reductions from the theoretical efficiency, on account of the rather serious loss of heat by absorption into the working cylinder, which has to be cooled artificially in order to keep its temperature down to a point at which lubrication is possible; this together with frictional loss cannot be taken at less than one-half, and reduces the factor of efficiency of the engine to 1-4th.

It follows from these considerations that the gas or caloric engine combines the conditions most favourable to the attainment of maximum results, and it may be reasonably supposed that the difficulties still in the way of their application on a large scale will gradually be removed. Before many years have elapsed we shall find in our factories and on board our ships engines with a fuel consumption not exceeding 1 pound of coal per effective horse-power per hour, in which the gas producer takes the place of the somewhat complex and dangerous steam boiler. The advent of such an engine and of the dynamo-machine must mark a new era of material progress at least equal to that produced by the introduction of steam power in the early part of our century.

Dr. Siemens then considered the probable effect of such an engine upon our merchant navy, and gave interesting statistics from "Lloyd's Register of Shipping." He also touched upon the hydrographic department of the navy, and the subject of tidal action :—

The application of iron and steel in naval construction rendered the use of the compass for some time illusory, but in 1839 Sir George Airy showed how the errors of the compass, due to the influence experienced from the iron of the ship, may be perfectly corrected by magnets and soft iron placed in the neighbourhood of the binnacle, but the great size of the needles in the ordinary compasses rendered the correction of the quadrantal errors practically unattainable. In 1876 Sir William Thomson invented a compass with much smaller needles than those previously used, which allows Sir George Airy's principles to be applied completely. With this compass correctors can be arranged so that the needle shall point accurately in all directions, and these correctors can be adjusted at sea from time to time, so as to eliminate any error which may arise through change in the ship's magnetism or in the magnetism induced by the earth through change of the ship's position. By giving the compass card a long period of free oscillation, great steadiness is obtained when the ship is rolling.

Sir William Thomson has also enriched the art of navigation by the invention of two sounding machines; the one being devised for ascertaining great depths very accurately in less than one quarter the time formerly necessary, and the other for taking depths up to 130 fathoms without stopping the ship in its onward course. In both these instruments steel pianoforte wire is used instead of the hempen and silken lines formerly employed; in the latter machine the record of depth is obtained not by the quantity of wire run over its counter and brake wheel, but through the indications produced upon a simple pressure gauge, consisting of an inverted glass tube, whose internal surface is covered beforehand with a preparation of chromate of silver, rendered colourless by the sea-water up to the height to which it penetrates. The value of this instrument for guiding the navigator within what he calls "soundings" can hardly be exaggerated; with the sounding machine and a good chart he can generally make out his position correctly by a succession of three or four casts in a given direction at given intervals, and thus in foggy weather is made independent of astronomical observations and of the sight of lighthouses or the shore. By the proper use of this apparatus, such accidents as happened to the mail steamer *Mosel* not a fortnight ago would not be possible. As regards the value of the deep-sea instrument, I can speak from personal experience, as on one occasion it enabled those in charge of the cable s.s. *Faraday* to find the end of an Atlantic cable, which had parted in a gale of wind, with no other indication of the locality than a single sounding, giving a depth of 950 fathoms. To recover the cable a number of soundings in the supposed neighbourhood of the broken end were taken, the 950 fathom contour line was then traced upon a chart, and the vessel thereupon trailed its grapnel two miles to the eastward of this line, when it soon engaged the cable, twenty miles away from the point where dead reckoning had placed the ruptured end.

Whether or not it will ever be practicable to determine oceanic depths without a sounding line, by means of an instrument based upon gravimetric differences, remains to be seen. Hitherto the indications obtained by such an instrument have been encouraging, but its delicacy has been such as to unfit it for ordinary use on board a ship when rolling.

Here the lecturer dwelt upon the great engineering works of the present day, beginning with the Panama Canal, the gigantic undertaking recently commenced by M. de Lesseps. He also mentioned jointly with this project the ship railway of Captain Eads, which is intended to take the largest vessels, from sea to sea, over a railway across the Isthmus of Tehuantepec, a distance of ninety-five miles. A third enterprise with which the name of M. de Lesseps is connected was touched upon, that of flooding the Tunis-Algerian Chotts.

Dr. Siemens then dealt consecutively with the new Eddystone Lighthouse, the St. Gothard Tunnel, the English Channel Tunnel, the undermining of the estuaries of the Severn and Mersey for the purpose of connecting the railway systems on the two sides, and the spanning of the Frith of Forth by a bridge exceeding in grandeur anything as yet attempted by the engineer. He concluded this portion of his discourse by his remarks on the researches of Prof. Abel and Captain Noble on the action of explosives.

The extraordinary difference of condition before and after its ignition, of such matter as constitutes an explosive agent leads us up to a consideration of the aggregate state of matter under other circumstances. As early as 1776, Alexander Volta observed that the volume of glass was changed under the influence of electrification, by what he termed electrical pressure. Dr. Kerr, Govi, and others have followed up the same inquiry, which is at present continued chiefly by Dr. George Quincke, of Heidelberg, who finds that temperature, as well as chemical constitution of the dielectric under examination, exercises a determining influence upon the amount and character of the change of volume effected by electrification; that the change of volume may under certain circumstances be effected instantaneously as in flint glass, or only slowly as in crown glass, and that the elastic limit of both is diminished by electrification, whereas in the case of mica and of gutta-percha an increase of elasticity takes place.

Still greater strides are being made at the present time towards a clearer perception of the condition of matter when particles are left some liberty to obey individually the forces brought to bear upon them. By the discharge of high tension electricity through tubes containing highly rarefied gases (Geissler's tubes), phenomena of discharge were produced which were at once most striking and suggestive. The Sprengel pump afforded a means of pushing the exhaustion to limits which had formerly been scarcely reached by the imagination. At each step the condition of attenuated matter revealed varying properties when acted upon by electrical discharge and magnetic force. The radiometer of Crookes imported a new feature into these inquiries, which at the present time occupy the attention of leading physicists in all countries.

The means usually employed to produce electrical discharge in vacuum tubes was Ruhmkorff's coil; but Mr. Gassiot first succeeded in obtaining the phenomena by means of a galvanic battery of 3,000 Leclanché cells. Dr. De La Rue, in conjunction with his friend Dr. Hugo Müller, has gone far beyond his predecessors in the production of batteries of high potential. At his lecture "On the Phenomena of Electric Discharge," delivered at the Royal Institution in January, 1881, he applied a battery of his invention consisting of 14,400 cells (14,832 Volts), which gave a current of 0·054 Ampère, and produced a discharge at a distance of 0·71 inch between the terminals. During last year he increased the number of cells to 15,000 (15,450 Volts), and increased the current to 0·4 Ampère, or eight times that of the battery he used at the Royal Institution.

With the enormous potential and perfectly steady current at his disposal, Mr. De La Rue has been able to contribute many interesting facts to the science of electricity. He has shown, for example, that the beautiful phenomena of the stratified discharge in exhausted tubes are but a modification and a magnification of those of the electric arc at ordinary atmospheric pressure. Photography was used in his experiments to record the appearance of the discharge, so as to give a degree of precision otherwise unattainable in the comparison of the phenomena. He has shown that between two points the length of the spark, provided the insulation of the battery is efficacious, is as the square of the number of cells employed. Mr. De La Rue's experiments have proved that at all pressures the discharge in gases is not a current in the ordinary acceptation of the term, but is of the nature of a disruptive discharge. Even in an apparently perfectly steady discharge in a vacuum tube, when the strata as seen in a rapidly-revolving mirror are immovable, he has shown that the discharge is a pulsating one; but, of course, the period must be of a very high order.

At the Royal Institution, on the occasion of his lecture, Mr. De La Rue produced, in a very large vacuum tube, an imitation of the Aurora Borealis; and he has deduced from his experiments that the greatest brilliancy of Aurora displays must be in an altitude of from thirty-seven to thirty-eight miles—a conclusion of the highest interest, and in opposition to the extravagant estimate of 281 miles at which it had been previously put.

The President of the Royal Society has made the phenomena of electrical discharge his study for several years, and resorted in his important experiments to a special source of electric power. In a note addressed to me Dr. Spottiswoode describes the nature of his investigations much more clearly than I could venture to give them. He says: "It had long been my opinion that the dissymmetry shown in electrical discharges through rarefied gases must be an essential element of every disruptive discharge, and that the phenomena of stratification might be regarded as magnified images of features always present, but concealed under ordinary circumstances. It was with a view to the study of this question that the researches by Moulton and myself were undertaken. The method chiefly used consisted in introducing into the circuit intermittence of a particular kind, whereby one luminous discharge was rendered sensitive to the approach of a conductor outside the tube. The application of this method enabled us to produce artificially a variety of phenomena, including that of stratification. We were thus led to a series of conclusions relating to the mechanism of the discharge, among which the following may be mentioned:—

"1. That a stria, with its attendant dark space, forms a physical unit of a striated discharge; that a striated column is an aggregate of such units formed by means of a step-by-step process, and that the negative glow is merely a localised stria, modified by local circumstances.

"2. That the origin of the luminous column is to be sought for at its negative end; that the luminosity is an expression of a demp- -

for negative electricity, and that the dark spaces are those regions where the negative terminal, whether metallic or gaseous, is capable of exerting sufficient influence to prevent such demand.

"3. That the time occupied by electricity of either name in traversing a tube is greater than that occupied in traversing an equal length of wire, but less than that occupied by molecular streams (Crookes' radiations) in traversing the tubes. Also that, especially in high vacua, the discharge from the negative terminal exhibits a durational character not found at the positive.

"4. That the brilliancy of the light with so little heat may be due in part to brevity in the duration of the discharge; and that for action so rapid as that of individual discharges, the mobility of the medium may count as nothing; and that for these infinitesimal periods of time gas may itself be as rigid and as brittle as glass.

"5. That striæ are not merely loci in which electrical is converted into luminous energy, but are actual aggregations of matter.

"This last conclusion was based mainly upon experiments made with an induction coil excited in a new way, viz., directly by an alternating machine, without the intervention of a commutator or condenser. This mode of excitement promises to be one of great importance in spectroscopic work, as well as in the study of the discharge in a magnetic field, partly on account of the simplification which it permits in the construction of induction coils, but mainly on account of the very great increase of strength in the secondary currents to which it gives rise."

These investigations assume additional importance when we view them in connection with solar—I may even say steller—physics, for evidence is augmenting in favour of the view that interstellar space is not empty, but is filled with highly attenuated matter of a nature such as may be put into our vacuum tubes. Nor can the matter occupying stellar space be said any longer to be beyond our reach for chemical and physical test. The spectroscope has already thrown a flood of light upon the chemical constitution and physical condition of the sun, the stars, the comets, and the far distant nebulæ, which have yielded spectroscopic photographs under the skilful management of Dr. Huggins, and Dr. Draper of New York. Armed with greatly improved apparatus the physical astronomer has been able to reap a rich harvest of scientific information during the short periods of the last two solar eclipses; that of 1879, visible in America, and that of May last, observed in Egypt by Lockyer, Schuster, and by Continental observers of high standing. The result of this last eclipse exhibition has been summed up as follows: "Different temperature levels have been discovered in the solar atmosphere; the constitution of the corona has now the possibility of being determined, and it is proved to shine with its own light. A suspicion has been aroused once more as to the existence of a lunar atmosphere, and the position of an important line has been discovered. Hydrocarbons do not exist close to the sun, but may in space between us and it."

To me personally these reported results possess peculiar interest, for in March last I ventured to bring before the Royal Society a speculation regarding the conservation of solar energy, which was based upon the three following postulates, viz.:—

1. That aqueous vapour and carbon compounds are present in stellar or interplanetary space.

2. That these gaseous compounds are capable of being dissociated by radiant solar energy while in a state of extreme attenuation.

3. That the effect of solar rotation is to draw in dissociated vapours upon the polar surfaces, and to eject them after combustion has taken place back into space equatorially.

It is therefore a matter of peculiar gratification to me that the results of observation here recorded give considerable support to that speculation. The luminous equatorial extensions of the sun which the American observations revealed in such a striking manner (with which I was not acquainted when writing my paper) were absent in Egypt; but the outflowing equatorial streams I suppose to exist could only be rendered visible by reflected sunlight, when mixed with dust produced by exceptional solar disturbances or by electric discharge; and the occasional appearance of such luminous extensions would serve only to disprove the hypothesis entertained by some, that they are divided planetary matter, in which case their appearance should be permanent. Prof. Langley, of Pittsburg, has shown by means of his Bolometer, that the solar actinic rays are absorbed chiefly in the solar instead of in the terrestrial atmosphere, and Captain Abney has found by his new photometric method that absorption due to hydro-carbons takes place somewhere between the solar and terrestrial atmosphere; in order to test this interesting result still further, he has lately taken his apparatus to the top of the Riffel with a view of diminishing the amount of terrestrial atmospheric air between it and the sun, and intends to bring a paper on this subject before Section A. Stellar space filled with such matter as hydro-carbon and aqueous vapour would establish a material continuity between the sun and his planets, and between the innumerable solar systems of which the universe is composed. If chemical action and reaction can further be admitted, we may be able to trace certain conditions of thermal dependence and maintenance, in which we may recognise principles of high perfection, applicable also to comparatively humble purposes of human life.

We shall thus find that in the great workshop of nature there are no lines of demarcation to be drawn between the most exalted speculation and commonplace practice, and that all knowledge must lead up to one great result, that of an intelligent recognition of the Creator through His works. So then, we members of the British Association, and fellow-workers in every branch of science, may exhort one another in the words of the American bard who has so lately departed from amongst us:—

> Let us then be up and doing,
> With a heart for any fate;
> Still achieving, still pursuing,
> Learn to labour and to wait.

CALLENDER'S INSULATING MATERIAL.

SOME two months since we paid a visit to the Bitumen Works of Callender's Company, for the purpose of inspecting the manufacture of a new insulating compound prepared from crude bitumen. We were then favourably impressed with its adaptability for the above purpose. Upon the invitation of the Messrs. Callender we have had an opportunity during the last week of making a series of tests on several sections of vulcanised bitumen core, amounting altogether to some four miles.

The electromotive force of the battery we employed for this purpose was 300 volts, and ten minutes' readings were taken with each current on the lengths submitted to us. The size of the core was No. 18 copper, covered to No. 7 B. W. G.

As we shall shortly have occasion to take further tests, we do not purpose publishing the figures we obtained at present, and shall therefore content ourselves with stating that the results were highly satisfactory, and that the good opinion we had already entertained of this substitute for gutta-percha and india-rubber was more than upheld.

Mr. Callender's invention consists in the use of bitumen, combined with other hydro-carbons, or their equivalents, so as to produce a compound material. The natural deposit of bitumen is obtained from Trinidad, and is refined in the usual way. It is combined with oil residue, obtained by subjecting vegetable or other oils to distillation for such a time and in such a manner as to leave the residues in an elastic condition. In some cases Mr. Callender employs with these materials ozokerit, paraffin, or other wax, but this is not always essential.

The compound is then vulcanised, and it is then found to be an efficient substitute for either india-rubber or gutta-percha. The ingredients used are, of course, comparatively inexpensive, and the result is that the compound material can be manufactured and applied at a price considerably less than either of the former insulators. This method of covering wires being of quite recent date, we cannot give any particulars as to the lasting capabilities of the material, but being a mineral substance, and not vegetable, it would appear that it should be practically imperishable. We have no object in recommending Mr. Callender's system other than in the interests of electrical industries, and we have therefore no hesitation in saying that we believe Mr. Callender's invention is the beginning of great advances in cheapening our present insulated conductors. We shall note carefully the results of the tests of this material from time to time, as improved manufacture brings out more prominently the advantages promised by the use of the compound. At the present moment we can safely say that the subject on which we have made these remarks is one eminently worthy of the consideration of electricians; for whatever class of work they may be engaged in, they must all feel the want of reliable means of insulating wires otherwise than by the use of the two best known and most expensive materials.

THE EDISON ELECTRIC LIGHT AT THE GENERAL POST-OFFICE.

THE Edison Electric Light Company has completed an important installation at the General Post-office.

The officials at the Post-office have for some time been desirous of lighting the operating rooms in some satisfactory manner by the electric light. In the Press room, at the top of the buildings in St. Martin's-le-Gran[illegible] there are engaged some 1,200 operators. A consider[illegible] portion of these are engaged on night duty, and it [illegible] portant that this room should be well illuminated. [illegible] from the vitiation of the air by gas, it is obviou[illegible] health of the operatives and their capability f[illegible] be increased by some system of illuminatio[illegible] light without unnecessarily heating the apar[illegible] "systems" of electric light have been tried. [illegible] objection to most of these, apart from fail[illegible]

has been that the space of the Post-office is far too valuable to spare for dynamos and engines and boilers. Hence the problem remained unsolved.

It has now however received its solution at the hands of the Edison Electric Light Company. As is well known, the fundamental principle of the Edison system is the supply of electricity from a central station. For five months, without intermission, the Holborn Viaduct has been so supplied from the station at No. 57, Holborn Viaduct.

The shops, streets, hotels, and church, have received without fail the current necessary to supply them with light. On being applied to by the Post-office authorities to extend this supply system, the Edison Company complied with the request by laying down a cable along Newgate Street. The distance from the dynamo-room to the Press department in the Post-office is 1,950 ft. A cable composed of eight No. 10 wires was laid down in a creosoted teak trough under the pavement. Starting from the extremity of the electric mains previously laid down on the Viaduct subway, the cable extends for 1,014 ft. to the entrances to the Post-office. It was important to secure a sufficient insulation. This was achieved by overlaying the cable with insulated tape, and then laying it in grooves in the trough on bearers of insulite, placed one foot apart. The trough was then sealed up with the usual insulation compound. At intervals five testing stations were established. The total copper resistance of the double length of cable is 0·024 ohms. On entering the building the cable runs up the wall in an iron pipe, and enters the operating room. One of the Edison electric meters registers the amount of electricity which passes in. In the operating room, 63 of the 16-candle Edison incandescent lights are placed. These are, at present, attached to the gas fixtures. Over each electric lamp is a porcelain shade to throw down the light on the operator's work. At each branch wire leading to the lamp is one of the "safety catch protectors," consisting of a lead wire of such gauge as to carry the normal amount of current for each lamp, but to fuse with any excess. The evil effects of an accidental cross in the wires are thus prevented.

The whole of this work has been carried out by the company's staff in about ten days.

On Monday night the lamps were lighted for the first time in the presence of the officials of the Post-office. On turning off the gas and switching on the current, the room was silently illuminated with a uniform light, steady, soft, and considerably exceeding in brilliancy the gas which it replaced. The contrast between the calm, cool illumination of that portion of the gallery lighted by the incandescent light and that portion which still suffered under gas illumination was very marked.

No one who witnessed the experiment of last Monday night could fail to be struck with the absurdity of the remark still occasionally heard that electric lighting is still in an "experimental stage." In this case we have more than sixty lights, giving a uniformly steady light, absolutely under control by switches on each lamp and on each circuit supplied on a meter from a station nearly one-third of a mile away. A few lights are also to be placed in another room in the building. Nothing could better have demonstrated than this installation the exact adaptability of the Edison incandescent light for night work requiring good illumination.

A SINE-RHEONOME.—By E. v. Fleischl.—A wooden ball of 4·5 centimetres diameter, covered with coils of thick wire, revolves within a hollow wooden ball of 6 centimetres in diameter, composed of two halves, and covered with many coils of fine wire (2 kilometres in length). By means of suitable connections a current is passed through the coil of the internal ball. In the coils of the outer ball, which are parallel to those of the inner, a current is induced by rotation of the inner on an axle parallel to the plane of the coils. The induced electromotive force varies as the sine of an equally increasing arc.—*Wiedemann's Beiblätter.*

APPLICATIONS OF ELECTRICITY TO THE TRANSMISSION OF FORCE IN THE FRENCH MINES.

THE transmission of force to a distance by means of electricity has been confined almost entirely up to the present to the domain of pure speculation or of laboratory experiments. While noting these researches, made by professional electricians, it is not uninteresting to describe the experiments of a more practical nature made by the engineers in certain French mines. We shall find in them very careful observations and information all the more useful because it is not based on fixed ideas or interested considerations, having for their object to show the superiority of a certain system over all others.

The most important application to which we wish to call the attention of our readers is that made at the mines of La Perronière by MM. Charousset and Bague. The results obtained were communicated by the experimentalists to the *Société de l'Industrie Minérale* at the last Congress held at Alais in December, 1881; the report of MM. Charousset and Bague was published in full in the bulletin of the society. We shall select from it the essential parts, leaving out certain definitions too elementary for our readers, and certain other parts which relate more to the working of mines than to electricity.

The transmission of force at the mines of La Perronière has for its object to dispense with the extraction by means of horses which, with the mode of working necessitated by the conditions of the mine, would have been too hard work. These conditions necessitated the placing of an inclined descent on the line of the greatest slope of the grant, and a windlass placed at the head of the descent.

The distance between the motor and the windlass, which is itself placed 555 metres below the soil, is 1,200 metres, made up as follows:—

	Metres.
From the motor to the head of the oaken shaft ..	25
The length of the shaft	390
A gallery almost straight	380
A false shaft	30
A rounded gallery	290
A false shaft	25
A gallery..	60
Total length	1,200

This long distance rendered the employment of steam impossible; the necessity of laying down and maintaining 1,200 metres of tubes of compressed air, through winding galleries and shafts, also excluded that agent; therefore recourse was had to electricity.

The complete installation comprises a horizontal steam engine, placed near the drawing-shaft, and working two Gramme machines (generators), which send the current to two similar machines (motors), which work a windlass placed at the head of the descent. This descent, which serves to draw up the coal-tubs, is really 110 metres long, following the slope, and has an inclination of 40 centimetres per metre.

Generating Machines.—The motor which works the generating machines has a single cylinder and variable expansion, on the Meyer system, and is furnished with a Buss governor. It makes 65 revolutions per minute. The flywheel of the engine works an intermediate shaft, making 195 revolutions, which in its turn actuates a second intermediate shaft, performing 325 revolutions. This second shaft bears pulleys, which act directly upon the Gramme machine by friction; and for this purpose the extremities of the axles of the machines are furnished with rollers of compressed paper, and turning at 1,300 revolutions.

The type of Gramme machine employed in the mines of La Perronière is that called *octagonal*, with four poles and four collecting brushes; the corresponding poles are placed opposite to each other, and the ring changes in polarity four times in each revolution.

Receiving machines and windlass.—The receiving machines disposed inside the mine, bear, like those outside, two friction rollers of compressed paper. They are placed symmetrically in relation to the transmitters, and oscillate round a horizontal axle which serves them as a support. This frictional motion is utilised for the starting and the stopping of the windlass. The oscillation of the

Gramme machines in one direction brings the friction rollers into contact with the pulleys which are connected with the windlass by means of straps, and effect the starting. The oscillation in the contrary direction draws back the friction rollers and stops the windlass.

The slackening of speed at the commencement is effected by allowing the rollers to rub against the pulleys. In order that these operations may be performed regularly, independently of the degree of skill of the workman, the regulation of the oscillation of the machines is effected by means of a system of jointed levers and a screw worked by a fly-wheel. The degree of contact which must not be exceeded is determined by a second screw which arrests the movement of the former one. These very clever arrangements allow of the slackening of speed at the starting and arrival of the coal tubs at the head of the descent.

The Gramme machines always turn in the same direction owing to the arrangement of the brushes; changes of direction are effected by a cog and two conical wooden pinions, gearing with the same bronze wheel; this change is always made when the machines are at rest and out of gear. The motors turn at a speed varying from 6-10ths to 9-10ths of the speed of the generators, according to whether they are geared or turning freely.

The windlass comprises a cylinder 1·50 metres in diameter, on which are coiled two cables, 15 millimetres in diameter. A brake acts upon this cylinder so as to stop it when the Gramme machines are out of gear. The mechanic being above the machines can see the attaching of the coal-tubs, and also their descent; and besides, a screw with index indicates to him at any moment their exact position.

Near the workman at the windlass are two commutators, which are never to be used for the normal working; this workman communicates with the one outside when he wishes to stop the machine, or send an order to him by means of a telephonic apparatus, known as M. Locht-Labye's *pantéléphone*, an apparatus of great simplicity, and one which, when properly regulated, is not likely to get out of order.

Conductors.—The generating machines are connected with the motors by four insulated conductors; they form two completely independent transmissions, each generator having a connecting wire and a return wire for feeding the corresponding motor.

The insulation of the conductors was in principle the cause of certain difficulties now overcome; they had to be changed three times. They consist now of a strand of sixteen copper wires of 11-10 millimetres covered, first, with two layers of paraffined cotton; secondly, with a layer of gutta-percha 5 millimetres thick; thirdly, with two layers of cloth coated over with Chatterton's composition; and, fourthly, with a stout covering of tarred cotton.

The cable thus supplied by the manufacturer was covered again at the mine with a very adhesive and at the same time highly insulating material composed thus:—

Norwegian tar	57 parts.
Resin	38 ,,
Suet	5 ,,

This coating is laid on in order to preserve the layer of cotton from damp and hot gases. The cable costs 3 francs per metre.

In the shafts and galleries these cables are laid at a distance of at least 20 centimetres from each other. In the galleries they are supported on grooved planks extending from one beam to another of the gallery. If it is necessary to examine or repair them, it is sufficient to remove a few of the planks. The cables then being insufficiently supported fall to the floor of the gallery.

The most highly insulated cables are only placed in the damp parts, about 450 metres, the remaining 750 consisting of a cheaper kind of cable, at only 1·25 francs the metre. The insulation of these cables consists of a layer of paraffined cotton, covered with two envelopes of cloth coated with Chatterton's composition, the whole being protected by a layer of cloth coated with india-rubber.

Passage of the current.—We have seen that in the octagonal machine the collector has four brushes instead of two, as in the ordinary machines. These collectors can be grouped into two distinct pairs, and the current considered as being furnished by two distinct rings. These two rings are grouped *in quantity;* the current supplied by each passes through half the inductors, and the extremities of the wire are attached to the terminals of the generating machines, like two distinct machines grouped in quantity. The corresponding motor is mounted in the same manner; the whole of the electrical circuit is therefore identical with that of two similar dynamo-electric machines also joined up *in quantity.*

The four Gramme machines also form two distinct groups, each having a generator and a motor. Thus each group can be made to work separately, or the two groups together, according to the work to be performed.

Practical results.—MM. Charousset and Bague have made several very interesting experiments relative to the amount of work effected, the speed of the machines, the losses, &c. These experiments have brought forward some curious, almost unknown facts, at which we will take a rapid glance. In the first place they observed what has been thought for a long time, that when the speed of the motor increases the intensity diminishes, and that the intensity increases when the work effected increases. Unfortunately up to the present the experimentalists have only had simple galvanoscopes at their disposal, in which the function which connects the intensity with the angle of deviation is unknown. It was therefore impossible for them to determine the electrical conditions of the working of the transmission. Nevertheless, it is interesting to note the mechanical results. The experimentalists studied first the influence of the charge on the speed of the motors by imparting to the generators a constant speed of 1,280 revolutions, the conductors being in good condition as to insulation. Five series of experiments gave on an average the following results:—

Generators.	Motors.	Charge.
1,280	975	Windlass turning alone.
1,280	880	400 kilogrammes.
1,280	830	800 ,,
1,280	810	1,200 ,,
1,280	780	1,600 ,,

Sometimes a phenomenon was produced, somewhat curious at first sight, but easily explained. The motors, which are identical with the generators as to length and thickness of wires, &c., can, under certain conditions, acquire a speed greater than that of the generators. This fact may be attributed to several causes. The first has to do with the position of the brushes, adjusted with more or less nicety to the relative speeds of the two machines, and to the currents supplied by them; the second relates to bad insulation of the wires; the third to a contact between the spirals of the inductors of the motor, which MM. Charousset and Bague term a shortening of the electro-magnets, the effect of which is to weaken the magnetic field of the motor, and consequently to force it to turn at a greater speed in order to develop the same counter-electromotive force. This remark is of great importance, for it shows what an error can be made by asserting, as certain writers do, that the ratio of the speeds of two identical dynamo-electric machines coupled, one as generator, the other as motor, gives the theoretical *result* of the transmission. This is only true when there is no shortening of the electro-magnets, and when the brushes are well set, conditions difficult to realise in practice, especially with high tensions. Without the reservations we mention, we might find results greater than unity, which is simply absurd.

We will now give the *practical results* of the transmission according to whether the machines worked one, two, three or four coal-tubs on the descent of 110 metres, with an inclination of 40 centimetres per metre. We must here observe that if the figures relating to the results are not very high, it is because the experimentalists have included in the work expended all the passive resistances independent of the electrical transmission. In reality, the work *expended*, as given in the table, refers to the work indicated on the diagram of the steam engine, and the work produced is expressed in kilogrammes of coal drawn up the inclined plane. Thus in the charge of the electrical transmission are included the resistances attributable to the steam engine, the intermediate transmissions, the state of the road, the work expended on the windlass, the friction of the wheels of the coal-tubs on their axles, &c., &c.

These figures are, therefore, really the practical result under certain special conditions, and constitute a minimum which will be far exceeded in practice, when we only attribute to the electrical transmission the losses which legitimately belong to it.

Remarks.—The numbers in columns 1 and 2 are expressed in kilogrammetres. In order to reduce them to *chevaux vapeur*, they must be divided by 75.

EXPERIMENTS.	Work expended according to the diagram. 1.	Useful Work. 2.	Speed of Generator. 3.	Speed of Motor. 4.	Practical result. 5.
1. Steam engine working freely	312	0			
2. Engine with transmission ...	458	0			
3. Engine with generator, open circuit	518	0			
4. Engine with generator and motor turning freely	530	0			
5. Steam engine with windlass alone	610	0	1,280	975	
6. Steam engine with 1 coal-tub	1,050	128	1,280	880	12·2
7. ,, ,, 2 ,,	1,200	223	1,280	830	18·6
8. ,, ,, 3 ,,	1,370	317	1,280	810	23·1
9. ,, ,, 4 ,,	1,530	400	1,280	780	26·1

The above table shows that the engine with transmission absorbs 458 kilogrammetres per second. When we subtract this number from the total required for the engine when drawing four coal-tubs, the expenditure of work is only 1,072 kilogrammetres per second, and the practical result measured by the weight of coal raised is 37 per cent. It would be still higher and would amount to about 50 per cent. if the work effected were measured, not by the weight of coal raised, but directly on the axle of the motor.

Up to the present only one generator and one motor have been used; the steam engine employed is much too powerful for the result actually obtained, but soon the two generators will be used; the second motor will be adapted to another windlass acting on another descent.

Remarks on the cables.—The cables not covered with gutta-percha answer the purpose very well in the galleries where the air is dry, but become deteriorated in damp places after a month's use. The workmen received shocks on touching them, or on touching the stones of the sides of the shaft in the neighbourhood of the conductors. The lead covered cables, the insulation of which was not sufficiently thick, also gave bad results. The lead melted in certain places, and the cloth coated with Chatterton's composition was burnt at the points where the lead had disappeared. The copper wires showed globules of melted metal. It is probable that derivations to earth were established between the two conductors of the machine. The cables covered with gutta-percha gave the best results, and since they have been employed there has been no hitch.

Summary.—MM. Charousset and Bague have concluded from their observations that electricity employed to transmit force to a distance will replace with advantage, as regards the results obtained, the cost of installation and especially of maintenance, compressed air and mechanical traction, especially in the following cases:—

I. When the mine is not too much impregnated with fire-damp.

II. When the distance between the motor and the receiver is great.

III. When the galleries destined to receive the medium of transmission cables, pipes, or chains, are winding, when only one series of galleries and false shafts meeting at right angles are at our disposal for transmission.

The experiments made at a distance of three kilometres showed that the result varies very little with the distance.

We must avoid dampness as far as possible, as we are free to take the longest path for the cable, and also vibrations which are injurious. When the transmission is effected by friction, pulleys turned perfectly true should be used, and finally the ratio of the speeds of the generators and motors should be maintained at about 0·6, whatever may be the effect to be produced. We see that the installation established at the mines of La Perronière furnishes us with very valuable *practical* information on the installation of transmissions of motive force in mines.

In a future article we shall discuss what has been done at Montceau-les-Mines, and at Saint-Claude for applications of the same kind.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE CITY AND GUILDS OF LONDON INSTITUTE TECHNOLOGICAL EXAMINATIONS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your correspondent "Fareham" seems to consider it an established fact that the "Cowper Street Student" is possessed only of an "examinational" knowledge of telegraphy. Such being the case, it may reassure him to know that the aforesaid student is practically engaged in electrical testing, though not in the Postal service, and probably does as much testing in one day as his unfortunate friend does in a month.

I am, Sirs, faithfully yours,

THE STUDENT.

THE RIVAL TELEPHONE COMPANIES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your correspondent "Justice" has a little more of *law* than of *justice* in his composition. He lays down with airy authority that, "any transmitter, combining a diaphragm with a tension-regulator, be it Hunnings', Dolbear's, or Anders', is clearly an infringement." This is surely a little premature. How does "Justice" know that Anders' transmitter is such a combination? Has he ever seen one? Will he describe its parts? If he cannot—and I defy him to do so, because I know he has never seen one—he belies his pseudonym. Again, if his verdict were the voice of justice Reis's transmitter of 1861 would be an infringement of Edison's patent, because it undeniably combines a diaphragm with a tension-regulator. This would be truly "Justice's" justice, to declare that the invention of 1861 was an infringement of the patent of 1877. No doubt Edison is as angry as any one else that an obscure German should have stolen his ideas sixteen years beforehand. It is clearly an in-"Justice" to so great an inventor. But stay, was not the great inventor himself started on the quest by having a manuscript translation of a paper on Reis's Telephone put into his hands by the President of the Western Union Telegraph Company? Does not the great inventor himself say so in Prescott's "Speaking Telephone?" If so, where is the

INJUSTICE?

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Pardon me for expressing my great astonishment that you should (no doubt unwittingly) have even suggested in your remarks on "The Telephone Industry" to the too timorous, that the United Telephone Company think Edison's single claim covers any semi-conductor placed in between any two points of a telephonic circuit, especially when you have before you the full reports of the evidence and judgments in two suits brought by the United Telephone Company for infringements of Edison's and Bell's patents. The last surviving claim out of thirty in Edison's notorious much-disclaiming patent is in these words:

"In an instrument for transmitting electric impulses by sound the *combination* with a diaphragm or tympan of electric tension-regulators, substantially as hereinbefore described for varying the resistance in a closed circuit, substantially as set forth."

In the Edinburgh case Lord M'Laren used these words:—

"Edison's patent is not for a specific instrument, but for a combination;" and further on he said, "I suppose if Theiler dispensed with a diaphragm, he would be without

the patent, because the tension of the diaphragm is the material point;" to this the Lord Advocate, counsel for the United Telephone Company, replied, 'Yes.'"

Lord M'Laren further said, "Now, as Edison's patent is for a tension-regulator in combination with a diaphragm or tympanum, it follows that the interdict would not apply to the use of the respondent's carbon regulator without a tympanum," and being satisfied that the respondent's instrument involves the combination of a tension-regulator with a tympanum, the complainers (the United Telephone Company) are entitled to protection by interdict under Edison's patent."

In the case decided by Mr. Justice Fry, in May last, the learned Justice said: "The true meaning of the second claim in Edison's patent is the union of a tympan or diaphragm capable of vibrating under the sound-waves with an electric tension-regulator;" and further, "I have concluded that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension-regulator," and I have come to the conclusion that the Hunnings transmitter is the combination of a diaphragm vibrating with the voice with a tension-regulator, and therefore is an infringement of Edison's."

To these two decisions I will add that of Lord Cairns (L.R. 1, app. ca. 574) (L.R. 3, app. ca. 34): "If it is clear that the claim is for a combination, and nothing but a combination, there is no infringement unless the whole combination is used, and it is in that way immaterial whether any or which of the parts are used." Those who may believe that two added to two does not make four may also believe that Edison's claim is not limited to "a combination," and that it covers any semi-conductor placed in a telephonic circuit.

I may here add that the judgment of Lord Cairns applies in all its force to Bell's claims of "the combination of an electro-magnet or of a permanent magnet with a plate of iron or steel or other material capable of inductive action." It may not be amiss just now to give publicity to the following law: "Should a person injure the business of another by pretending that that other's manufacture is an infringement of a valid patent when such is not the case, the aggrieved party can obtain costs and damages, and obtain a perpetual injunction restraining him from further intimidation on pain of fine and imprisonment."

I beg however to dissent from your opinion, that this is "an unsatisfactory state of affairs," in regard to the unique claim of Edison's patent; on the contrary, the present state of affairs under the decisions above referred to is perfectly satisfactory, and the use of carbon in tension-regulators *without* a diaphragm is open to all the people of the United Kingdom, as is also the case in a telephone of a magnet in combination with a diaphragm, disc or plate of any material *not* capable of inductive action.

In my transmitters I use various forms of carbon tension-regulators without a diaphragm or tympan, or a colourable imitation thereof, and in my telephones I use various forms of permanent magnets and of electro-magnets without a plate, or disc, or diaphragm of any material capable of inductive action or any colourable imitation thereof, and I challenge any person to gainsay the rights I claim to use those devices, and at the same time I caution all persons against pretending that my inventions, viz., patent 4905, November 9, 1881, and 2259, May 13, 1882 (under which I have manufactured and have sold instruments), are infringements of any valid patent.

If the owner of any valid patent believes that my instruments are infringements of his patents, let him take legal notice forthwith of my avowal or beware of what the law terms "laches."

Yours truly,

W. C. BARNEY.

53, Bernard Street, *August 20th*, 1882.

[Mr. Barney throws out a bold challenge here to the United Telephone Company to contest their exclusive right to carbon tension-regulators. Our correspondent, however, has apparently overlooked the fact that in our article we expressed ourselves as having different views on the matter in question to those promulgated by the United Telephone Company. We rather think that Mr. Barney has erroneously considered "inductive *action*" to be synonymous with "induction."—EDS. ELEC. REV.]

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I herewith send to you a continuation of my report of patents for telephone receivers for 1880-1881.

List of British patents for telephone receivers in which a disc capable of inductive action is used in combination with a magnet:—

1880.

No.	Date.	Inventor.	Remarks.
158	January 14th	Crossly	
752	February 28th	Eaton	
1,738	April 20th	Russell	
2,610	June 26th	Gower	
3,473	August 27th	St. George	
3,885	September 25th	A. G. Bell	
4,981	November 30th	Randall	

Telephones without a disc capable of inductive action:—

No.	Date.	Inventor.	Remarks.
2,419	(?) June 15th	Lockwood & Bartlett	

1881.

Telephones with a disc, capable of inductive action:—

No.	Date.	Inventor.	Remarks.
93	January 8th	Herz	
286	January 22nd	Konigslieb	
542	February 8th	Sax	
1,885	May 2nd	Main	
5,385	December 9th	Foster	
5,430	December 12th	Rose	
5,431	December 12th	Rose	

Telephones without a disc capable of inductive action:—

No.	Date.	Inventor.	Remarks.
1,395	March 29th	Dolbear	No magnet
4,905	November 9th	Barney	
5,028	November 16th	Theiler	

1882.

No.	Date.	Inventor.	Remarks.
2,259	May 13th	Barney	

All the patents for transmitters from December 9th, 1876, to January 13th, 1882, have the combination of a diaphragm, with a tension-regulator, except No. 4,905, November 9th, 1881, Barney; and this consists of a number of carbon pencils, the ends of which rest loosely in carbon blocks, which form two sides of a frame, the other two sides being of any non-conducting material, without any back or front.

Yours truly,

COMMON SENSE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I am delighted that Count du Moncel is beginning to see daylight dawn upon Reis's telephone. He admits that Reis's receiver will receive when the transmitter is good, he admits too that Reis's transmitter will transmit when the receiver is good. The only difficulty now remaining is the difficulty of admitting that a receiver, which will receive, and a transmitter which will transmit, will work together as receiver and transmitter. It is simply a question of fact, Reis and his contemporaries did succeed in transmitting intelligible speech; though they tell us honestly that the vowels were often bad. I have had no great difficulty in succeeding myself, and with reasonable precautions, such as keeping the membrane dry, not shouting too loud, &c., the experiment is simple.

Count du Moncel thinks it "very extraordinary" that such an important discovery did not obtain more publicity. That the lack of greater publicity is "very extraordinary" may be true, but that does not disprove the facts. It only proves that either the fact was so very extraordinary that men did not believe it, ... or else that they did not read German.

But I must be permitted emphatically to differ from Count du Moncel when he charges me with having "not kept to the subject," when I made some remarks on the question of the use of semi-conductors. I quite agree that the question of semi-conductivity has nothing to do with the question. But it was Count du Moncel himself who introduced that very irrelevant point into his preceding letter.

As Count du Moncel continues to reiterate that a loose contact between two good metallic conductors will not produce telephonic effects as well as a loose contact between two imperfect conductors, permit me to reiterate, on my part, what Count de Moncel has neither disproved nor denied, and which he must both deny *and* disprove experi-

mentally before his arguments can have any weight, viz., that if you take an ordinary Blake transmitter, and in place of the bad-conducting button of carbon, put in a bright polished button of the very best conducting metal, silver, the transmitter will transmit speech just as well as before.

I particularly invite Count du Moncel to do me the favour first to *deny*, secondly to *disprove* this result.

Yours faithfully,
SILVANUS P. THOMPSON.

ELECTRIC LIGHTING TENDERS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In the report of the statutory meeting of the Metropolitan Brush Electric Light and Power Company, Limited, published in your issue of 19th instant, the following question was asked by a Mr. Price: "The Camberwell Streets Committee asked for tenders to light with electricity the streets in their district; only one tender was sent in. Was it theirs? And if not, why did they not tender?" To this question Mr. Hammond replied: "The one tender sent in to the Camberwell vestry was that sent by this company, the Brush." And he further stated, "he Mr. Hammond would be the last man to dodge the question asked," &c., &c., &c. Will you allow me most emphatically to contradict the above? The only tender sent in was sent for the Pilsen-Joel and General Electric Light Company, Limited. The statement was made to me when, as the representative of the company, I handed in the Pilson Company's tender; and further, the Pilsen-Joel and General Electric Light Company's tender was the only one sent in for another metropolitan district, viz., West Ham. And there are many other cases in which the Pilsen Company is the only company in the field.

Yours respectfully,
JAMES BEATTIE.

Representing the Pilsen-Joel and General Electric Light Company, Limited.

THE BRITISH ASSOCIATION.

BY OUR SPECIAL REPORTER.

SOUTHAMPTON, Wednesday Evening.

THIS morning the 52nd annual meeting of the great scientific congress of the year was opened here amid much enthusiasm. Thirty-six years have elapsed since Southampton was thus honoured, the last occasion being in 1846, when Sir Roderick Murchison presided. Both Southampton and science have advanced, in the generation that has elapsed since that date, by "leaps and bounds," and the very elaborate arrangements for the conduct of the 1882 meeting of the Association may be regarded as the tribute of modern commerce to the scientific knowledge which has so much contributed to its advance. The reception room at the Victoria Hall, which forms the centre of the operations of the Association, has been specially provided with telegraphic, telephonic, and post-office conveniences, such as had not entered into the minds of the scientists of 1846 even to conceive, and the whole town is *en fête* with streamers and bunting, while the arrangements and invitations for visits of pleasure are exceptionally complete and numerous. The congress opens its annual "palaver" under the most favourable auspices, and the 1,070 members and associates who have up to the moment of writing announced their presence may look forward to a pleasant as well as an interesting and instructive *séance*. To-day was mostly devoted to preliminaries. The Council of the Association met at 10 a.m. in the Victoria Rooms, the General Committee followed at 1 p.m. to consider and adopt the council's report, a meeting of Sectional Committees took place at two o'clock, and the skating rink was crowded to the door in the evening to hear the formal beginning of Association work in the shape of the inaugural address by Dr. Siemens, the president for the year. The council, in its report, after noting the corresponding members elected during the year, refers to the loss sustained by the untimely death of Prof. F. M. Balfour, F.R.S., the late general secretary. They request authority for taking steps to ascertain the feeling of foreign scientific associations as to the advisability of holding an international scientific congress, and announced that they have made a contribution of £100 towards the expenses of an expedition for the exploration of the snowy mountain range of Eastern Equatorial Africa. They further recommend the re-election of certain members who retire by rotation. The report was generally approved of by the general committee after a somewhat languid discussion on some minor details. In the evening the Southampton streets began to fill with an unwonted bustle, and amidst a downpour of rain a converging crowd of scientists and local notables, with a large proportion of ladies, surged towards the skating rink, where Dr. Siemens was to take the sceptre from the hand of Sir John Lubbock. The rink was gaily decorated, and in front of the platform a large silk banner waved, on which was embroidered the armorial bearings of the president elect, with his motto, "Aus Eigener Kraft," prominently displayed. In resigning his chair Sir John made felicitous and graceful reference to Dr. Siemens being of foreign birth, and distinctly scored one when he remarked that he was himself the best illustration of the *energy* upon which he believed he was to speak that evening. Dr. Siemens was received with enthusiastic cheers on rising to read his address, and his slow and deliberate utterance was intently listened to during the hour and three quarters that it lasted. At the close of the address a vote of thanks was passed by acclamation on the motion of W. H. Davis, Esq., Mayor of Southampton, seconded by Dr. Spottiswoode, president of the Royal Society. The platform list included the following names amongst many others: Sir John Lubbock; Sir Richard Temple; Sir Frederic Bramwell; Sir William Thomson; Prof. Abel; Prof. A. W. Williamson, Ph.D., F.R.S.; Prof. De Chaumont, M.D., F.R.S.; Mr. Hawksley, C.E.; Mr. John Fowler, C.E.; Capt. Douglas Galton; M. Du Bois-Raymond; Dr. Werner Siemens; Dr. Spottiswoode (President of the Royal Society); M. P. de Tchihatchef, of Florence; Mr. W. H. Barlow, C.E., F.R.S.; Prof. W. F. Barrett, F.R.S.E.; Mr. R. Etheridge, F.R.S.; and Sir Joseph Hooker, F.R.S.

The programme during the session is in outline as follows:—

THURSDAY.—The Sections meet at 11 a.m. In the afternoon the Mayor and Mayoress give a reception at the Municipal Offices. At 8 p.m. the Local Committee give a soirée at the Hartley Institution, which will be lighted by the electric light, supplied by the Edison Company.

FRIDAY.—Sections at 11 a.m. At 3 p.m. the Committee of Recommendations will meet at the Reception Room. In the afternoon the Mayor and Mayoress give a reception at the Municipal Offices; and in the evening, at 8.30, Sir William Thomson, Professor of Natural Philosophy at the University of Glasgow, will deliver a discourse on "The Tides" at the Skating Rink.

SATURDAY.—The Sections meet at 11 a.m. The afternoon will be devoted to excursions—(1) to Alum Bay and the Needles; (2) the New Forest; (3) Netley Abbey and Netley Hospital, where Surgeon-General Holloway, C.B., and the officers of the Army Medical Department will give a garden party to about 300 at the officers' mess; (4) Romsey Abbey and Broadlands Park, where the members will be received by Lord and Lady Mount Temple at tea; and (5) Winchester and St. Cross. At 7 p.m. a popular scientific lecture to the operative classes on "Unwritten History, and how to read it," is to be given at the Skating Rink by Mr. John Evans, D.C.L., F.R.S. The arrangements for this lecture have been carried out by a local working men's committee.

SUNDAY.—At 10.45 the Bishop of Truro will preach at St. Mary's Church (Broad), the members and associates, with the Mayor and Corporation, attending. The same morning, at 11, the Rev. C. Pritchard, Savillian Professor of Astronomy at Oxford University, will preach at All Saints' Church (Evangelical).

MONDAY.—Sections at 11 a.m. At 3 p.m. the officers for 1883 will be elected and the place of meeting in 1884 fixed. In the afternoon Canon Basil and Mrs. Wilberforce give a garden party in the Deanery grounds. At 6.30 for 7 o'clock a special Provincial Grand Lodge of Hants and Isle of Wight Freemasons will be held at the Masonic Hall in Albion Place, opposite All Saints' Church, in order to welcome Freemasons visiting Southampton. At 8.30 p.m. in the Skating Rink, Mr. H. N. Mosely, M.A., F.R.S., Linacre Professor of Human and Comparative Anatomy at Oxford University, will deliver a discourse on "Pelagic Life."

TUESDAY.—Sections at 11 a.m. At 3 p.m. meeting of Committee of Recommendations; at 8 p.m. a soirée at the Hartley Institution, at the invitation of the Mayor and some members of the Corporation.

WEDNESDAY.—At 10 a.m. meeting of Committee of Recommendations; at 1 p.m. the General Committee will meet at the Skating Rink to receive the report of this Committee of Recommendations; and at half-past 2 in the afternoon the concluding meeting of the Association takes place.

THURSDAY will be devoted to excursions—(1) to Salisbury and Stonehenge, or Wilton; (2) Ryde, Brading (for the Roman Villa), or Whitecliff; and (3) two marine excursions, including Portsmouth.

The Queen has assented to an application for the members of the Association to visit Osborne after her departure for Scotland, which will probably be about Friday next; and the Union Steamship Company will issue invitations for a whole day marine excursion on their steamer *Pretoria*.

By telegram we learn that on Thursday the business of the Association commenced in earnest, and the section of Biology in particular has not proceeded further than the presidential address. In two of the departments a respectable amount of work, as represented by the papers read, has been got over up to the hour at which sectional meetings stood adjourned. The number of tickets issued at 3 p.m. was 1,150, which it is understood contrasts somewhat unfavourably with the issues of recent years, but the attendance of the various departments has been fully up to the usual average.

The numerical honours of the day may be said to have fallen to the mechanical science section in which Mr. John Fowler delivered his presidential address to a crowded house.

Mr. Fowler reviewed the progress of engineering science in a graphic and humorous fashion, the audience being particularly tickled by the contrast which he drew between the performance of the engines at the opening of the Liverpool and Manchester railway in 1830, when thirty-three miles were got over in five hours with the aid supplied by passengers walking up all the inclines; and the mile a minute speed to which the present generation is so accustomed.

Dr. Siemens, in proposing the vote of thanks, rather complained that the President had omitted to discuss the progress of applied electricity, but the address may be looked at as one of the most comprehensive of the day.

Mr. Baker followed with a most exhaustive account of the Forth Bridge, which manifestly interested his auditors to no common degree.

Lord Rayleigh led off the Mathematical Section by a suggestive little address respecting the qualifications required for, and the dangers to be avoided in, scientific research. The large portion of the audience who remained to hear Mr. Darwin's paper on Gravitation Disturbance were well rewarded both by the paper itself and by Sir William Thomson's interesting criticism. The succeeding subjects covered a wide field, from the recent Eclipse and Spectrum Analysis to the Velocity of Light and "Some Matters concerning the Sun." The Chemical Section, after Prof. Liveing's address, was poorly attended, and the same may be said of the Geological and Economic departments, though the names of Leone Levi, Mr. Abel, and Mr. Etheridge guaranteed the quality of the fare presented. To-morrow may be regarded as the steadiest working day that the Association will have at its disposal. Saturday's and next week's holidays must distract the attention of even *savants*. This afternoon has brought us a large accession of names of note, including Dr. Gladstone, Profs. Adams, Cayley, Milne, Stewart, and Schuster, Sir Henry Bessemer, Mr. Glaisher, and others. An element of discomfort is the threatening weather, but it is hoped that the success of the gathering will not be thereby seriously disturbed.

NOTES.

ERRATUM.—Page 131, column 1. Maxim light—read "Edinburgh" for "Glasgow."

DANGER FROM ELECTRIC LIGHTING.—We are informed upon good authority that the two deaths occurring recently in the Tuileries were occasioned by the current from an alternating current Siemens' dynamo-electric machine.

Le Ménestrel states that the electric light nearly caused a conflagration at the Paris Opera last week during a performance. The current being too strong, the wires became red hot, and their gutta-percha covering being quickly destroyed, the adjacent inflammable material began to smoulder, and the services of the firemen had to be called ition.

ELECTRIC LIGHT INSTALLATIONS.—We are glad to observe that signs of improvement are visible in the erection of electric light apparatus. Mr. Dickson, in addressing those present at the first general meeting of the Brush Electric Light and Power Company of Scotland, said, in reference to the lighting of Waverley Station, "The North British Company are quite aware of whom they are dealing with. They only had 16 arc lights last year, and they have now given us an order for double that number. We are carrying out that order with an efficient staff and proper instruments, so that the sort of slipshod way in which it was done before will not recur in the management of your board of directors."

SECONDARY BATTERIES OR ACCUMULATORS.—The *New Haven Evening Register* of America in speaking of the "Sutton" secondary battery says: "This form of battery was improved upon by Charles E. Buell of this city, who employed common lead shot, coated with mercury, and placed in a porous cup. He put this cup in a glass cell and surrounded it with a coil of copper-wire cloth, which served as the positive electrode. The employment of shot and wire cloth furnished the greatest surface in a given weight and constitutes a form most easily made. Mr. Buell verifies the published statement of Mr. Sutton that a cell four inches high and four inches in diameter will keep a No. 28 iron wire at red heat for two hours; that it is more constant, and does not polarise during discharge, as does the Faure battery. It weighs very much less, occupies less space, and costs less than the Faure battery of like force, and is untrammelled by patent rights."

THE ELECTRIC LIGHT IN HOLBORN.—Information has been sent to us that the Pilsen-Joel, and General Electric Light Company has secured the following orders:—At the Inns of Court Clothing Company and the Bon Marché Clothing Company, respectively, four Pilsen arc lamps, giving a stated luminosity of 2,000 candles each. These will be worked from the station in Whetstone Park to which we have already referred.

THE PILSEN-JOEL AND GENERAL ELECTRIC LIGHT COMPANY.—We believe that the statutory meeting of this company will shortly be held, and it will be interesting to the shareholders to know what progress has been made since its formation. We were under the impression that the system of lamps and machines worked by this company would give it a leading position in the electric lighting world, and we still hold the same opinion, but for reasons we cannot fathom the operations of the Pilsen-Joel Company do not appear to be so energetic as promised in the beginning. This, however, it is to be hoped will soon be remedied, if the directors have any wish to meet the demands likely to be put upon their resources during the forthcoming winter. It is evident that the working arrangements of this company are not yet all that could be desired; in fact, it is but too apparent that there is considerable room for improvement. We would strongly urge upon the directors, in their own interests and in those of their shareholders, to give the subject their earnest and prompt attention. With their good system and business management the Pilsen-Joel Company should be second to none. Commercial ability solely has made one prominent company the enormous success it is.

NEW METHOD OF INSULATING ELECTRIC WIRES.—M. H. Geoffroy has just presented to the Academy of Sciences a process of insulating conducting wires, with the object of preventing all chances of fire, even when the wires are in contact with combustible materials. This process consists in covering the conducting wires with a coil of asbestos fibres and then placing them in a leaden tube as is generally done; the wire can be entirely volatilised without the spark communicating with the outer coverings, the lead not showing any signs of fusion. With a powerful current the volatilisation of the wire lasts the tenth part of a second; the copper being once burned the current is naturally interrupted. Besides, the electrical insulation is satisfactory.

TRANSMISSION OF ELECTRICITY FOR LIGHTING PURPOSES.—At the meeting of the Metropolitan (Brush) Electric Light Company, a full report of which appeared in the ELECTRICAL REVIEW of last week, Mr. Hammond said, in the course of his remarks, that the Charing Cross Railway Station was lighted from the Brush Company's station at Lambeth, *a thing which was only possible with the Brush system.* Mr. Hammond had evidently overlooked the lighting of Victoria (underground) Station by the Jablochkoff Company from their station on the Thames Embankment. He should also be aware that it is quite *possible* for the British Electric Light Company, Messrs. Siemens Brothers, the Pilsen-Joel, &c., Company, and others to extend their systems to long distances from a central station if they choose to construct their machines so as to give a dangerously high electromotive force. At the same meeting Mr. Wm. Ladd spoke in much the same strain as Mr. Hammond, and if his remarks could be looked upon as true, then the Brush machine is superior in every way to others.

THE ELECTRIC LIGHTING BILL.—The Board of Trade notify that the rules with respect to applications for licenses under the Electric Lighting Act of 1882 may be obtained from P. S. King, King Street, Westminster; Knight and Co., 90, Fleet Street, E.C.; Shaw and Sons, Fetter Lane, E.C.; Hadden, Best and Co., 227, Strand, W.C.; A. and C. Black, Edinburgh; and A. Thom and Co., Dublin.

THE LIGHTING OF THE MANCHESTER ROYAL EXCHANGE BY THE BRITISH ELECTRIC LIGHT COMPANY, LIMITED. (Extract from the *Manchester Courier*, Tuesday, August 22nd, 1882).—"It will be remembered that a short time ago the directors of the Manchester Royal Exchange decided to test the capability of the electric light in the illumination of the building, and last evening an experiment was made in the lighting by electricity of the interior of the structure with most satisfactory results. At the same time two lamps were brought into operation on each side of the portico in Cross Street, the effect being that they completely eclipsed what had been up to then considered the brilliant light of the recently introduced patent gas lamps in the adjoining part of Market Street."

SPREAD OF ELECTRIC LIGHTING.—At the last meeting of the Fulham District Board of Works the seal of the board was affixed to an agreement with the West Middlesex Electric Light Company empowering the company to lay wires enclosed in pipes under the footways throughout the parishes of Fulham and Hammersmith. The distance of the roads in the district is 39 miles, and the number of houses 29,000. It is proposed to erect at suitable points central stations upon a large scale within the two parishes for the purpose of generating the electricity. For street lighting Brockie's arc lamps will, at present, be fixed, and for shops and private houses the British incandescent lamp. The light is already being extensively sought after by many of the largest tradesmen in the district, who are desirous of using it. The Brush Midland Electric Light Company (Limited) have entered into a contract for the lighting of the town of Cleethorpe for the next three years. The Severn Tunnel Works, Monmouthshire, are also being lighted on the Brush system, and preparations are being made for extensive lighting at Bristol, Newport, and Cardiff during the coming winter. At St. Martin's-le-Grand the Edison incandescent system has been fitted up in the newsroom. The current is sent from the company's central station on Holborn Viaduct, a distance of about half-a-mile. At Southampton the theatre of the Hartley Institution is being illuminated by this company's system during the meetings of the British Association. At the forthcoming North East Coast Exhibition at Newcastle, the Gülcher, Hammond, and Pilsen-Joel Companies are to display their respective systems. In Scotland there is also evidence of advance. In a recent issue we said the North British Company had decided to extend the electric light at their Waverley Station, Edinburgh. We learn that the number of lamps is to be increased from sixteen to thirty-two and that the cost to the company shall not exceed what they have hitherto paid for gas; which, it may be added, was manufactured by themselves. Each lamp is of 2,000 candle-power, and its cost is put down at $2\frac{1}{2}$d. per hour. In addition to this undertaking, the Scottish Brush Electric Light and Power Company are making arrangements for the lighting of Portobello station and goods loading depôt (one of the busiest stations on the North British system) by electricity at gas rates. A number of other stations are mentioned, among them Dundee, Arbroath, and Inverness. Private firms throughout the country are making inquiries and inviting tenders.

In New York wires have been laid down in the streets by the Edison Company and everything is on the eve of completion, so that by the first week in September a very considerable portion may be wholly lighted up by electricity.

PATENTS FOR INCANDESCENT ELECTRIC LAMPS.—We have received information that the British Electric Light Company have recognised the fact of their infringement of the Edison patents for electric lighting by paying a substantial sum as royalty to the Edison Electric Light Company, Limited. We are advised that this infringement refers only to a feature in the construction of the lamp.

THE GOVERNMENT AND THE TELEPHONE COMPANIES.—We extract from the *Times* the following letter, in reply to one signed "Electrician," part of which we published last week:—

SIR,—Your correspondent "Electrician" states the case of the Telephone Companies' so-called "free competition" well, so far as he goes. But in your article in the *Times* of to-day you speak of "enforcing, in the interests of the Crown and the public, only such conditions as are necessary to protect the revenue and to insure to the Post Office the means of competing freely on its own account."

Note the words, "only such conditions." One of the conditions is that the companies to whom licenses are granted shall supply the same class of instrument used on their lines for use by the Post Office in the same district for which the licence is granted. The price of these telephones to be fixed by arbitration.

The only companies to a certain extent exempt from this obligation to supply telephones are the United and the National.

Another condition is that the telephone companies, before erecting any line, shall supply to the engineer of the Post Office a plan showing how that line will run; and if the engineer thinks that it will interfere either with the existing Post Office wires or with any route they intend to lay out in future, the consent is refused, after the telephone company has had all the trouble and expense of obtaining way-leaves, &c.

In addition to the royalty of £2 per subscriber, the Post Office charges private companies a royalty of about £1 a mile per subscriber for communication between one centre and another; and before granting permission to make the connection makes the telephone company gurantee a *minimum* of eight subscribers. Thus, between Leeds and Bradford, a distance of only nine or ten miles, the Telephone Company is charged £10 per subscriber.

Is this fair competition? the Post Office paying no royalties on instruments and no tax to Government.

Faithfully yours,
FAIR PLAY.

London, *August 17th.*

THE OTRANTO-CORFU CABLE.—On Wednesday, the 16th instant, Mr. W. A. Killingbeck, the electrician to Henley's Telegraph Works Company, returned to England after effecting the repairs of the above cable. He left this country on the 10th of July, and commenced operations about a week afterwards. The fault was found about $1\frac{1}{2}$ knots from the Otranto end of the cable, and the repairs were completed in three days. We understand that the cable, which was manufactured by Messrs. Glass and Elliott is, for a submersion of over 20 years, in excellent condition. It will be remembered that we noticed the departure of the s.s. *Caroline* on this expedition, in our issue of July 8th. We hear that the same telegraph ship is now chartered by the Eastern Telegraph Company for their cable operations in the Mediterranean.

UNDERGROUND CABLE BETWEEN PARIS AND MARSEILLES.—We read that cast iron pipes are now being made to receive the underground telegraph cable which in a few months will put Paris in direct communication with Marseilles. One hundred and fifty navvies are engaged in this work, which is being prosecuted from both ends along the right bank of the Rhone, and following the main roads. The work is pushed forward with vigour, and it is proposed eventually to connect this cable, which will traverse France from north to south, with the cables of the Mediterranean and Atlantic.

CENTRAL AND SOUTH AMERICAN TELEGRAPHIC COMPANY.—We note the following in the *Panama Sta*-

Herald, dated July 18th: "A cablegram received in this city announces the death at Punta Elena, Ecuador, of Mr. MacLachlan, an operator of the Central and South American Cable Company, who left for that point per *Casma*, on her last trip south. The deceased gentleman had formerly been in the Atlantic cable service, and only arrived here per *Bolivia*, on the 27th of last month. It appears that in riding from the port, Mr. MacLachlan fell from his horse and fractured his skull, dying from the effects late on the 6th inst. Prior to his departure from Panama, he had mentioned the fear he felt at having to ride some distance, never having mounted a horse before in his life, and his melancholy death affords another proof that sometimes the shadow may unwittingly be felt of a coming event. There is no operator for the telegraph company at Punta Elena, and the office will consequently have to remain in the contractor's hands, even should the cables be turned over to the company.

India-Rubber Production in Brazil.—A pamphlet, lately issued in Rio de Janeiro by Senhor Pimenta Bueno, calls attention to the great importance of this product, and the influence it has had on the commerce of Para, the value of whose imports and exports has risen from 26,332,580 mils during the years 1849-1854, to, in 1874-1879, 108,702,684 mils, or fully four times as much during the last five years, while the revenue of the city has increased during the same period from 4,368,527,650 reis to 17,825,895,567 reis, having during the five years previously, say, from 1869 to 1874, reached the large sum of 21,245,591,032 reis. To show the proportionate value of india-rubber, as compared with other exports, the return for 1879-1880 apportions them as follows:—

India-rubber	12,242,500 mils
Castanha nuts	1,473,800 ,,
Cacao	1,032,500 ,,
	14,748,800 ,,

On the other hand, the total exports from the two provinces of Para and Amazonas during the same period was 15,497,600 mils, a striking proof of the position held by india-rubber. It is further stated, that "the provinces of Para and the Amazonas import sugar, coffee, Indian corn, beans, and even mandioca flour." Again, the writer of the pamphlet states that india-rubber occupies the third place in the exports of the empire after coffee and sugar, and yet how few of our readers are probably aware of this fact. Para occupying the extreme northern limits of the empire, with its vast river, the Amazon, flowing past.

The writer shows how, owing to the destructive manner in which the india-rubber trees are cut down, this valuable branch of industry is threatened with serious diminution, if not almost extinction, and urges that means ought to be taken to regulate the cultivation and supply of this valuable article, a conclusion in which most people must agree who feel an interest in Brazil, as well as the great river which gives access from Para to the Andes, and whose banks are covered with primeval forests, many as yet almost untrodden by the foot of man.

A great increase in the value of the article is exhibited, that current being 3,100 reis per kilogramme for fine quality, whereas in the year 1825 it was only worth 300 reis the kilogramme. It may also be noticed that india-rubber contributes 25 per cent of its value to the general and municipal taxes of Para.

Magnetic Units.—We are promised shortly an article on magnetic units by Professor Silvanus Thompson, including an account of a magnetic measuring instrument which he has lately devised. This instrument is, we believe, almost identical with that described in our columns on 12th August, by Mr. F. J. Smith. It is, however, only fair to Professor Thompson to state that he mentioned the existence of his instrument to us before the appearance of Mr. Smith's description.

Personal.—Lieut.-Colonel C. E. Webber, R.E., the President of the Society of Telegraph Engineers and of Electricians, has been suddenly called to Egypt, having been appointed A. Q. M. General on the staff of Sir Garnet Wolseley. We believe the Lieut.-Colonel left England on the 18th instant. Sir Garnet has already had the advantage of Lieut.-Colonel Webber's assistance during the South African campaign of 1879.

We trust that before the meetings of the Society of Telegraph Engineers and of Electricians commence again, the Egyptian affair will be settled and the president once more amongst us, completing the term of office which he has up to the present so worthily and energetically filled. Lieut.-Colonel Webber may rest assured that his career in Egypt will be eagerly watched by many outside military circles.

Burglars and Electricity.—Mr. W. H. Akester, F.S.A., electrician to the Universal Electric Company, Glasgow, has been much annoyed for some months past by midnight burglars attempting to break into his residence at Balvaird, Rutherglen, near Glasgow. He has therefore been under the necessity of devising a plan of adapting electric bells so as to warn him of the approach of burglars, and it has proved at once effective and inexpensive. Late on Wednesday night last week, after the family had gone to bed, a couple of burglars opened the gate, which immediately caused the bell in Mr. Akester's bed-room to ring. From the indicator he knew that they were just entering by the gate. Mr. Akester immediately got out of bed and dressed in haste, by which time the bell rang again, the indicator showing that the thieves were at the front bed-room window, on the ground-floor. Thinking that the servant had not retired for the night, and knowing that the bell is sometimes inadvertently rung when closing the shutters of the window he called over the stair to see whether such was the case. No response was made and he proceeded to the point indicated. The burglars, who by this time had obtained access to the bed-room by the window, must have heard his voice, for, without taking any booty, they immediately cleared the window, took to their heels and decamped. Mr. Akester has had no further annoyance from them since. It is obvious that the application of electricity in the direction indicated above may be greatly extended.

A New Theory.—Those who attended at the City Hall, Glasgow, on the afternoon of Sunday last, heard a new theory propounded by Dr. Hately Waddell on the relationship of electrical science to his Satanic Majesty. Choosing for his text the words, "And I saw an angel come down from heaven having the key of the bottomless pit and a great chain in his hand, and he laid hold of the dragon and bound him a thousand years and cast him into the bottomless pit," Dr. Waddell explained that the terms dragon and devil were figurative expressions for falsehood, ungodliness, &c., and proceeded to ask if our successors on this mundane sphere were in the future to be continually looking up to the clouds for the angel spoken of in the text to come down and bind the devil for a thousand years. If ever angel, Dr. Waddell said, came down from heaven to earth for a work like this it was the angel of electrical science. It came direct from heaven. If such an angel brought a chain in his hand it was the telegraph wire and the submarine cable, coiled up and carried on his arm. If ever such an angel had such a key as spoken of in the text, it was the submarine telegraph. Although a thousand years had not yet been accomplished, they had begun, for of all agencies which human ingenuity, human industry, and courage ever carried out, or will ever carry out, this very agency of electric communication from door to door and from one end of the earth to the other, across deserts, over mountains, and under rivers, and deep oceans like the Atlantic and the Pacific, was the most wonderful. It was unquestionably a revelation from heaven. This was the mode of communication by which the devil himself was to be circumvented, surrounded, bound, and imprisoned, so that he dare not at the peril of his existence utter a lie in the hearing of mankind. If there was any place deeper than the bottom of the Atlantic in this terrestrial globe it would soon be found; and the devil, the father of falsehood, fraud, and imposition, would be sent headlong into perdition. Just in proportion as electricity circled the earth just in that proportion would the devil be defeated!

[If any incentive to work were required in the present state of electrical knowledge here is the golden opportunity.

There is something pleasant in the thoughts that electrical men have contributed in no small way to their own salvation without having been conscious of the fact until brought home to them by Dr. Waddell, "*which is tidings of comfort and joy.*"]

ELECTRICAL PHENOMENA IN THE ALPS, &c.—Mr. A. S. M. Buttemer, in a letter addressed to the *Times*, and dated Lausanne, July 26, gives the following description of some electrical phenomena observed by him during a thunderstorm which took place on the Matterhorn :—"The morning had been fine and warm, but about noon snow fell. On the top the sun came out, and the view on the Italian side was perfectly clear. About five minutes after commencing the descent the sky suddenly became dark, and snow fell in such density that, as one of our party described it, you could grasp a handful from the atmosphere. A peal of thunder made our guides hurry on. Directly afterwards we heard a sharp crack resembling the report of a rifle, and each of us felt a slight shock in the head. A peal of thunder followed instantly. The guide, who was carrying an ice axe, threw it away in alarm. A second and much louder crack followed in about a minute, and we all experienced a powerful shock. The guides felt it in the head, and one of them complained of a severe headache for the rest of the day. My wife described it as passing through the body. I felt it entirely in the knees, which seemed as if momentarily dislocated. Thunder followed immediately as before. After this there were a few distant peals of thunder, and in an hour the snow ceased and the sun came out."

A number of years ago M. Fournets, in an interesting communication brought before the members of the French Academy, showed that on the Alpine and Jura mountain chains exist points which are remarkable for electrical phenomena. The following are some of the effects related in the paper :—

Spontaneous Illumination of the Rocks on Mont Blanc.—During the night of the 11th of August, 1854, Mr. Blackwell was stationed in the Grand Mulets, when the guide, M. Couttet, went out of the little hut about eleven o'clock, and perceived that the edges of all the rocks around appeared as if on fire. He mentioned the fact to his companions without delay, and they all witnessed the phenomenon in question. A storm raged at the time, and under its electrical influence all the edges of the mountains appeared illuminated. Moreover, the clothes of the guides became literally covered with electric sparks, and when they raised their arms into the air their fingers became phosphorescent. At the same time (eleven o'clock at night) heavy rain fell at Lyons, with some thunder in the south-west, and the whole day previously the weather had been very stormy. The same guide, M. Couttet, of Chamounix, when he ascended Mont Blanc on the 25th of August, 1841, in company with M. Chenal, was overtaken by a storm which was extremely dangerous to them, for they were completely surrounded by the lightning. All the rocks and stones about the spot emitted numerous electric sparks, whilst the summit of Mont Blanc and the sky above were perfectly serene.

Electricity on the Breven.—The curious phenomena witnessed by De Saussure, Jalabert, and Pictet on the Breven (altitude 2,520 metres) in 1767 is thus related :—"The weather was very stormy. The travellers had only to extend their fingers or to raise their hands in order to feel a peculiar pricking irritation at their extremities. Pictet was the first to remark this, but the phenomena became in a short time much more intense, and was accompanied by a kind of hissing or buzzing noise. Jalabert, whose hat was ornamented with gold braid, according to the fashion of the period, heard a fearful buzzing noise around his head. Some electric sparks were obtained when the others approached their hands to the gold button on M. Jalabert's hat, or to the iron tip of his walking stick. The storm becoming very violent, the three travellers found it necessary to descend some thirty yards lower down on the mountain side, when they no longer felt these electrical effects.

Electric Snow on the Jungfrau.—On the 10th July, 1863, Mr. Watson and several companions visited the Col de la Jungfrau. The morning had been very fine, but on approaching the Col they perceived that heavy clouds had collected there, and as soon as they reached it the whole party was plunged in a strong gust of wind, accompanied with hail. Forced to return they mistook the road, and wandered for some time in the Latoch-Sittel. At this moment a formidable peal of thunder burst forth, and soon afterwards Mr. Watson heard a kind of hissing noise emanate from his stick. It was like the noise of a kettle boiling on the fire. The sticks and axes carried by the others presented the same phenomena. One of the guides took off his hat, exclaiming that his head was burning; and, in fact, his hair stood on end, like that of Mr. Watson's. The snow during this time emitted a sound similar to what might have been produced by a rapid shower of hailstones. No phosphorescent phenomena were observed, but it is highly probable that lights would have been seen if this had occurred at night. Many of the excursionists received electric shocks more or less intense. At about half-past twelve o'clock the clouds passed away and the above effects disappeared, after having lasted some five-and-twenty minutes.

Electricity on the Piz Surley.—On the 22nd June, 1865, M. A. de Saussure ascended the Piz Surley, starting from Saint Moritz in the Grisons. The Piz Surley is a granite mountain some 2,300 metres high. About one o'clock in the day small hailstones fell abundantly, and a kind of sleet covered the rocky needles and the snow-capped peaks around. The cold increased as our observer arrived at the summit of the Piz Surley about half-past one o'clock. The sleet and hail becoming more abundant, it was determined to make a halt, and to lunch under a pyramid of dry stones which crowns the peak. Resting his stick against this rough construction, Saussure felt a sharp pain in his left shoulder; it was like a pin penetrating slowly into his flesh. Thinking that a pin had found its way into his cloak, he took it off, but the pain only increased, and spread from one shoulder to the other. He then took off his coat, and whilst doing so, discovered the electrical nature of the phenomenon by the peculiar buzzing noise which issued from his stick. A little time afterwards he saw electric radiations emanate from his fingers when he raised his hands in the air. His companions noticed the same curious effects. A thunder-clap towards the west warned them that it was time to leave the summit, and they descended some hundred yards down the mountain. These various effects diminished as the travellers descended, and they stopped when their sticks ceased making any noise. The same day a violent storm broke over the Bernese Alps, and a young English lady on her wedding tour in these mountains was killed by lightning.

Field Lightning in the Jura.—Sometimes certain pasture grounds in the Jura district are seen literally covered by flashes of lightning, hence the phenomenon has been denominated *field lightning*. On the 25th August, 1865, between nine o'clock and mid-day two successive storms were noticed by M. Quiquerez, at Porentray, near Courtavon, at the foot of the Jura. At three o'clock in the afternoon a third storm arose, and the clouds were observed to be very low. Electrical effects manifested themselves with fearful intensity on the entire surface of the fields. The electric flashes succeeded each other with extreme rapidity, and formed long luminous tracts along the pasture land, instead of through the air. The general noise was such as to prevent isolated explosions or decrepitations being heard. No rain fell; but the observers of this strange phenomenon were almost in the cloud itself, and the ground was very wet by the rain which had fallen in the morning. The same day, some three or four leagues to the east of Morimont, along the same chain of mountains, but a few minutes later, fearful lightning played along the surface of the fields and pasture grounds, as if the herbage had been on fire. These storms spread as far as Lyons. Phenomena similar to what has just been narrated are occasionally observed at the surface of lakes and ponds. Arago tells that a farmer of Parthenay, in Vendée, saw a vivid flame spread over a pond during a storm which occurred in the night of the 4th September, 1767, and the next day all the fish in the pond were found dead upon the surface of the water. Something very similar happened on the 2nd August, 1850, at eight or nine in the evening on the Lac de Moret, and more recently on the Lac de Bienne.

THE POST OFFICE AND THE TELEPHONES.—With respe-' to the letter of "Fairplay" which we publish in

"Notes," and referring to that portion of his letter concerning the charge of £10 per subscriber between Leeds and Bradford, we may remind our readers that the Post Office Private wire rentals for the provinces—are, for the wire over house, or underground £7, and for roads £5, per mile per annum. If a double wire is rented the charge per mile is £13 10s. Hence if a single wire is used between Leeds and Bradford the charge will be £70, if a double wire £135. Notwithstanding the "conditions" by "Fairplay," there is evidence from all parts that the development of the telephone has received a great impulse from the Postmaster-General's statement that there should be fair competition.

NEW COMPANY REGISTERED.

MEDICAL CONSTANT CURRENT ELECTRIC COMPANY (LIMITED).—Capital, £100,000, in £1 shares. Objects: To purchase for £48,000 in fully paid shares the letter patent, No. 3443 of year 1882, for an improved medical battery. Signatories (with 1 share each): *H. Stanbrough, Gipsy Hill; *J. Wild Hulseberg, M.R.C.S., Upper Norwood; *William Allison, 22, Grosvenor Mansions; *Major-General C. J. Richards, Southsea; *Major A. Campbell-Walker, Walton-on-Thames; C. F. Tombs, 38, Lombard Street; E. Erskine Scott, 38, Lombard Street.

Directing qualification, £250, in shares. Remuneration, £150 per annnum to each director, with an additional £150 to the chairman. Registered 17th instant by W. T. Manning, 2, Westminster Chambers, Victoria Street.

* Signatories denoted by an asterisk are directors.

NEW PATENTS—1882.

3869. "An improved dynamo-electric motor engine." E. DESFOSSÉS. Dated August 14.

3881. "Electric lamps and conductors therefor." F. R. WELLES. (Communicated by C. E. Scribner and W. R. Patterson.) Dated August 15. (*Complete.*)

3882. "Telephone apparatus (switches)." F. R. WELLES. (Communicated by C. E. Scribner and W. R. Patterson.) Dated August 15. (*Complete.*)

3893. "Secondary or storage batteries." H. J. HADDAN. (Communicated by H. Aron.) Dated August 15.

3906. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated by P. Tihon and E. Régard.) Dated August 15.

3912. "Strengthening and checking electric currents." P. ADIE and W. S. SIMPSON. Dated August 16.

3941. "Secondary batteries, and methods of constructing the same." N. C. COOKSON. Dated August 17.

3946. "Receiving and recording telegraphic signals." B. H. CHARNEROY. Dated August 17.

3949. "Means or apparatus employed in or for supplying electricity for light, power, or other purposes." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 17.

3950. "Dynamo-electric machines, or electric generators, and apparatus connected therewith." S. Z. DE FERRANTI and A. THOMPSON. Dated August 17.

3951. "Improvements in water-motors, and in utilising the force of rivers and streams for the purpose of generating electricity, and in the means employed therefor." S. S. ALLIN. Dated August 18.

3955. "Incandescing electric lamps, and means connected therewith." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 18.

3961. "Secondary batteries." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 18.

3964. "Improvements in secondary or storage batteries, and apparatus connected therewith." H. T. BENNETT. Dated August 18.

3971. "Improvements in insulating compositions to be used in coating or covering wires and appliances employed in conducting electricity for telegraphic, telephonic, lighting, and other purposes." C. J. ALLPORT and R. PUNSHON. Dated August 19.

3974. "Dynamo electric power creating machines." J. E. T. WOODS. Dated August 19.

3975. "Secondary batteries and electric accumulators." J. E. T. WOODS. Dated August 19.

3976. "Electric lights." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 19.

3980. "Improvements in the insulation of wires and other electric conductors used for the production and transmission of electric currents." J. H. JOHNSON. (Communicated by I. M. Hirsch.) Dated August 19.

3982. "Electric signalling apparatus." R. H. BRANDON. (Communicated by H. W. Southwood.) Dated August 19. (*Complete.*)

3991. "Manufacture of incandescing conductors for electric [illegible]" T. J. HANDFORD. (Communicated by T. A. Edison.) August 19.

3995. "Underground conductors for electrical distribution." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 21.

3996. "Dynamo and magneto-electric machines for regulating the generation of current by such machines." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated August 21.

4003. "Improved safety devices for use with electric apparatus or conductors designed chiefly for preventing or diminishing fire risks." S. P. THOMPSON. Dated August 22.

4005. "Manufacture and composition of non-conducting tubes for electrical and other useful purposes. J. C. MARSH and R. J. SMITH. Dated August 22.

4025. "Working gear and appliances used in electric lighting." K. W. HEDGES. Dated August 22.

4034. "Generation, storage, distribution, regulation and utilisation of electricity and apparatus or means therefor." J. S. WILLIAMS. Dated August 22.

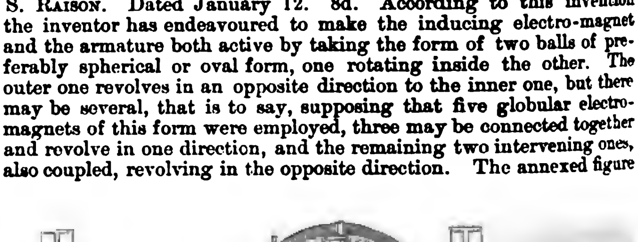
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

5477. "Electric lamps." W. R. LAKE. (A communication from abroad by C. F. de la Roche, of Paris.) Dated December 14. 6d. Relates to improvements in electric lamps or lighting apparatus. According to the said invention, the inventor develops the voltaic arc in the interior of a chamber or space provided in a block of any kind of refractory material, having in its walls or sides, openings in the form of the frustum of a cone, so as to allow the light produced to emerge in determined directions.

1882.

157. "Apparatus for electric lighting." G. HAWKES. Dated January 11. 8d. Relates to the construction of electric lamps, with a view to simplify the mechanism, shunts, and regulating gear in connection therewith. In constructing an electric lamp according to this invention, the inventor employs mercury or weights for the purpose of forcing the lower or negative carbon by means of tubes into proper position with the upper or positive carbon, and he regulates the ascent of the lower carbon by the varying action of a magnet or solenoid, which is placed in a branch circuit in the lamp. The duty of this magnet is to operate on a movable armature or keeper combined with a clutch or jam ring, turning on two centres, together with a spring descending from the outer one of two screws which operate from the upper one of two metal plates in the negative circuit. This spring in the first instance by its operation prevents the ascent of the lower or metal carbon, but gradually yields and allows it to approach towards the positive carbon, staying the progress, however, of the lower carbon at a proper distance to form the arc and according to the strength of the branch magnet. This action continues until both carbons are consumed or the current be shunted to the next pair.

169. "Electro-motors and dynamo-electric machines, &c." H. S. RAISON. Dated January 12. 8d. According to this invention the inventor has endeavoured to make the inducing electro-magnet and the armature both active by taking the form of two balls of preferably spherical or oval form, one rotating inside the other. The outer one revolves in an opposite direction to the inner one, but there may be several, that is to say, supposing that five globular electro-magnets of this form were employed, three may be connected together and revolve in one direction, and the remaining two intervening ones, also coupled, revolving in the opposite direction. The annexed figure



represents a longitudinal section of a machine constructed in accordance with the invention. a a is the inner core of cast iron, with projections, a^1 a^1, forming pole pieces. This core is cast in two halves, and is mounted on the shaft, x, being fixed thereon by a key, n, and steady pins, b: m is a fixed brass tube, with a groove cut therein to receive the wires, w w, and conduct them to the commutator. The face, g, and collar, p, serve as a guide against which the outer bearings revolve. The core of the outer coil is preferably built up of segments, n^1 n^1, which may be wound separately before fixing in position. The two segments which form the bearings are preferably of brass or other non-magnetic material. A number of openings are left which admit of air circulation to keep the machine cool and to lessen the heating or induction currents, or the core may be made of some non-conductor such as ebonite. The commutator is shown in

the figure, *a* and *b* are complete brass rings, c and c^1 are half rings, *s s* are the brushes pressing on the rings, the course of the currents is shown by the arrows.

178. "Signalling upon railways by means of electricity." C. E. SPAGNOLETTI. Dated January 12. 6d. Has for its object improvements in railway signals and signalling, and is also particularly suitable for working junctions and large station yards, where main lines are intersected by crossings, and shunting operations are frequent or continuous.

231. "Telephonic conductors." C. W. SIEMENS. (A communication from abroad by Frank Jacob, at present on board the steamship *Faraday*, on the high seas.) Dated January 17. 6d. As telephone instruments are usually arranged, a complete circuit is formed including in each case a battery, a sending instrument and a receiving instrument, these two instruments being connected by two insulated wires for the forward and backward electrical currents respectively. The two wires are often twined together in one cord, this having the effect of preventing interference by induction from adjacent wires. When a number of sets of telephonic instruments are employed it is necessary, as they are at present arranged, to provide in the manner described a complete circuit for each receiver, that circuit requiring the two wires as stated above. Now the object of this invention is to render a number of such pairs of wires capable of supplying an increased number of instruments, by arrangements such that one receiver can be worked for each wire instead of one receiver for each pair of wires, as at present. In order to illustrate the invention, let it be supposed that there are two adjacent circuits, A and B, as at present arranged, each circuit having its battery, its sender, its receiver, and its pair of wires, making in all four wires. Now the inventor forms an additional circuit, C, with its battery, sender, and receiver, using the pair of wires of the A circuit for the forward current and the pair of wires of the B circuit for the backward current. There is also formed a fourth circuit, with its battery, sender, and receiver, using the four wires of the C circuit for the forward current and earth for the backward current. In this manner four sets of instruments can be worked by the use of four wires. As another illustration let it be assumed as before that there are the two complete circuits, A and B, and that there are two other similar adjacent circuits, *a* and *b*. There is formed as above described a third circuit, C, by using the pair of wires of A for forward and the pair of wires of B for backward currents, and in a similar manner there is formed another circuit, *c*, by like use of the wires of *a* and *b*, or that there are six circuits with eight wires. But a seventh circuit, D, can be formed by using the four wires of C and the four wires of *c*, and an eighth circuit, E, by using the eight wires of D and earth for return. And thus eight circuits can be effected by the use of eight wires.

In carrying out this invention as above described, any known kind of conductors may be employed, and along with them suitable resistances, condensers, or other known arrangements for determining the various circuits. Fig. 1 of the accompanying drawings illustrates a simple combination in which the two wires, L, connecting two instruments, A and A^1, are utilised as a single line with extensions, l l^1, of any required length for connecting two other instruments, B and B^1, earth, E, being used for the return part of the circuit of the latter pair of instruments. The first instruments, A A^1, are conveniently situated within a bridge, in the limbs of which resistances, R, are introduced, these resistances being arranged so as to equalise the potentials on the two sides of each instrument. Fig. 2 illustrates a combination for working four pairs of instruments with four wires, employing earth for the return part of the circuit of the last pair. In this case the two pairs, A A^1 and A^2 A^3, are connected by their double wires, L L^1, respectively. These two pairs of wires, L D^1, complete a circuit for a third pair of instruments, C C^1, and the four wires of L L^1, with earth for return, complete a circuit for a fourth pair of instruments, D D^1. The instruments, A A^1, A^2 A^3 C C^1, are situated in bridges, with resistances, R, arranged in the limbs of the bridges. As stated above, it is usual to protect telephonic conductors against interference by induction by twining together the pairs of wires forming their respective circuits. When two such pairs are combined to operate for another circuit it is of advantage also to twine together the two strands, each consisting of a twined pair, thus producing a strand which in its turn may be twined with a similar strand when four pairs are combined, and so on according to the number of pairs of wires entering into the combination.

FIG. 1.

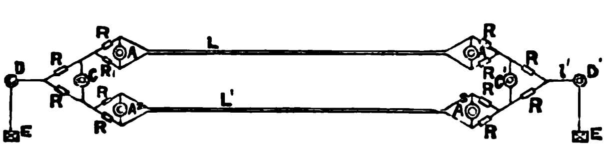


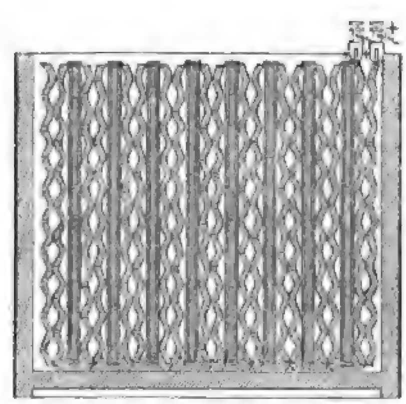
FIG. 2.

232. "Permanent way for electric and telephonic conductors." H. R. MEYER. Dated January 17. 6d. Relates to an improved permanent way for electric and telephonic conductors, such as wires, or ribbons used for telegraphic electric lighting, telephonic, electric power, and various other like purposes. According to the invention the inventor constructs an underground or subterranean permanent way for electric and telephonic purposes in the following manner. The inventor uses blocks, or slabs, or channels of any suitable non-conducting material such as glass, earthenware, porcelain, terra cotta, cement, or asphalte. The blocks, slabs, or channels are formed of any convenient section, and are tongued and grooved and otherwise attached together end to end. The upper surface of the block, slab, or channel formed with ridges projecting up on each side, and there are also provided such upper surfaces with grooves running longitudinally and the wires, ribbons, or their equivalent, are placed in these grooves. The wires, ribbons, or their equivalent, and all the joints of the permanent way are then covered with a suitable non-conducting material such as asphalte, tar, pitch, resinous gums, cement, paraffin, or stearines. The blocks, slabs, or channels are covered with slabs, flags, or slates of the same material as the blocks, or other suitable material. These covers are pitched to lap the joints of the underneath blocks, and are arranged to lap over each other and over the sides of the blocks, slabs, or channels.

234. "Dynamo-electric machines." W. R. LAKE. (A communication from abroad by C. A. Hussey and Amzi Smith Dodd, both of the City and State of New York.) Dated January 17. 6d. Relates to dynamo-electric machines. It is known that in these machines as ordinarily constructed, only those coils of wire which are passing between the poles or consequent points of the field-magnets are effective in producing currents of electricity, and that the other coils of the armature are for the time rather detrimental than otherwise because they offer a resistance to the passage of the current of electricity produced. One object of the present improvements is to effectually obviate this defect and to this end the said improvements consist in the combination in a dynamo-electric machine, of a field magnet and an armature severally having cores composed of arc-shaped portions wound with wire, intervening arc-shaped portions, and radial portions connecting the two series of arc-shaped portions; the radial portions of both the field-magnet and armature forming poles, polar extensions, or consequent points, and extending towards each other. The field-magnet core will preferably be made of one integral piece of metal and the armature-core of many thin pieces of metal.

245. "Apparatus for regulating electric currents." W. R. LAKE. (A communication from abroad by Achille de Khotinsky, of Paris.) Dated January 17. 6d. This invention has for its object to provide an automatic current regulator which is based on the following principles:—First. To establish, by means of a conductor with variable resistance, a derivation in the circuit of the current operating upon the bobbin of a dynamo-electric machine (either an exciting or a generating machine) before its entrance into the coils of the inducing electro-magnets, and so provide means for varying the electromotive force of the principal current. Secondly. To establish a derivation with variable resistance in the circuit of the current operating upon the bobbin before its entrance into the coils of the electro-magnets, and at the same time to place in the circuit of the current which excites the electro-magnets of the inductor another resistance whereby variations in the intensity of the principal current can be obtained.

252. "Electrical accumulators." H. H. LAKE. (A communication from abroad by La Société Universelle d'Electricité Tommasi, of Paris.) Dated January 18. 6d. Relates to secondary batteries or accumulators, its chief object being to improve the working and increase the power of such batteries by means of a considerable augmentation of the surface of the elements combined with a light weight and small volume. In carrying the said invention into practice each



element of the accumulator is formed of two continuous sheets of lead bent or folded several times and placed in a vessel of gutta-percha or other suitable material in such a manner that a double bend or fold of the one is always contained in a double bend or fold of the other; the sheets being thus placed in juxtaposition at a certain distance from and parallel to each other. The plates are also perforated with holes to allow of the circulation of the liquid. The arrangement is shown by the figure.

278. "Effecting electro-hydo-therapeutic treatment of patients affected by disease." W. A. BARLOW. (A communication from abroad by Messieurs L. Encausse et Canésie, of Paris.) Dated January 19. 6d. The apparatus is disposed in a chamber so that the whole treatment by both the cutaneous absorption and by electricity is effected in a regulated and simultaneous or successive manner. And this will be done without exposing the patient to any change in the temperature, which change is always injurious.

289. "Secondary batteries for storage of electricity." J. HUMPHREYS. Dated January 20. 4d. Relates to improvements in the con-

struction of secondary batteries for storing electricity. It consists in making the plates of which the scondary battery is composed of an open lattice form, that is to say, the sides of the framework of each plate are connected with bars, either of a diamond or oval section, these bars being arranged at an angle on the principle of a "Venetian" blind, thereby exposing a maximum area or surface of spongy lead to the action of the liquid used in the battery.

290. "Telephonic conductors." H. J. Haddan. (A communication from abroad by J. D. Morel, of France.) Dated January 20. 2d. Has for its object to record the conversation carried on through a telephonic conductor by combining with the same a phonograph. (*Provisional only.*)

302. "Voltaic batteries." A. R. Bennett. Dated January 21. 4d. Has for its object the production of a cheap and effective single-fluid voltaic battery. To form the negative portion of the battery the inventor places an electrode of iron or steel packed tightly in small fragments of the same metal, such as iron or steel turnings or borings, or clippings of iron or steel wire, in a solution of potassium monoxide, potassium hydroxide, sodium monoxide or sodium hydroxide. To form the positive portion of the battery, which should be separated from the negative by a porous cell or diaphragm, the same solution is used immersing in it an electrode of zinc, the shape of which is immaterial.

316. "Telephone transmitters." E. G. Brewer. (A communication from abroad by Joseph Olmsted, of New York.) Dated January 21. 6d. Relates to telephone transmitters in which the current from a galvanic battery passing through contact electrodes or points is varied by the impingement of the air waves or vibrations accompanying vocal sounds upon some portion of the instrument to which the electrodes are connected. The invention herein described as applied in connection with transmitters employing a disc or diaphragm, but the novel electrode or contact-piece herein described is applicable to other constructions of telephones, or may be used as a variable contact in a microphone. In telephone transmitters it has heretofore been common to employ but one electrode for making contact with the electrode which receives motion from the diaphragm, and in those cases where a number of electrodes have been employed making contact abreast or in multiple arc with a number of opposite electrodes or a single electrode common to them all, springs have been employed for holding the electrodes in contact and independent adjusting devices have been employed for the various electrodes. This invention consists, first, in a novel construction of telephone in which is employed a series of independently pivoted electrodes forming together a compound electrode, and resting against an opposite electrode by their own gravity, and mounted upon a common adjustable support whereby the same, or practically the same, initial contact is secured for all, and all may be adjusted together for vary-

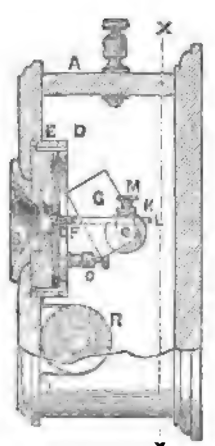


Fig. 1.

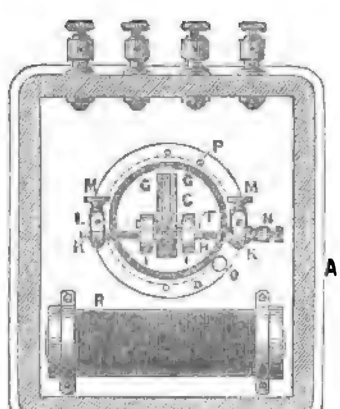


Fig. 2.

ing the contact. In former arrangements employing separate adjusting devices, it is impossible to determine the adjustment that will give the same contact for all, whereas in this arrangement, each electrode being actuated only by an invariable force like gravity, and all having a common adjustable support, the adjustment of the instrument can be accomplished with the certainty that the contact of all the electrodes has been varied to the same extent for all. This invention consists, secondly, in a novel contact or electrode composed of a thin sheet of carbonised paper or cardboard, or of a number of such sheets arranged side by side to make a compound electrode, said sheet or sheets being mounted so as to rest with its edge against the opposite electrode. A compound electrode thus constructed is very constant in its action, and transmits sounds with great volume and accuracy. Instead of carbonised paper a thin sheet of metal, like platinum or german silver, is sometimes used resting in the same manner with its edge against the opposite electrode. In the accompanying drawings fig. 1 is a partial vertical section of a transmitter embodying the invention. Fig. 2 is a rear view of the operative parts of the instrument, the back being removed. A represents the casing of the transmitter, B its mouth-piece, and C the metallic disc or diaphragm which is clamped between a ring, D, and a block, E, in any suitable manner, and is provided at its edge with a rubber dampening ring after a manner common in instruments of this class. F is an electrode which is attached to and moved with the diaphragm. 'ectrode consists of a longitudinal bar, having a bevelled edge ɪvided at or near its centre with a laterally projecting stud ich passes a screw by which said electrode is secured to the gm. The edge of the bar, F, which forms the contact edge, is, by preference, of platinum. G G represent thin sheets of carbonised cardboard or paper strung upon a rod, H, of some conducting material and contained between two blocks, I I, also attached to the rod. The plates, G G, rest with their edges in contact with the edge of the bar electrode, F. The rod, H, is mounted in brackets, K K, which are of hard rubber or similar non-conducting material, and are suspended or attached to rods, L L, mounted upon the clamping ring, D, or any suitable portion of the instrument. The non-conducting brackets may be adjusted horizontally upon the rods, L L, thus carrying with them the supported bar, H, and the electrodes, G, and adjusting the degree of initial contact between the electrodes of the instrument. Upon the end of the conducting-rod, H, is a binding screw, N, which serves for the attachment of one portion of the circuit wire coming from the galvanic battery. Electrical connection is made with the electrode, F, by means of binding-screw, O, which is mounted directly upon the clamping iron, D, of metal, the latter being electrically connected with the diaphragm by means of a screw, P, which passes through the ring, D, and against or into the edge of the diaphragm. M M are set screws which serve to hold the brackets, K, at any desired position upon the rods, L. R represents the induction coil of the transmitter, the primary coil of which makes a portion of a local circuit, including the electrodes, G, F, and a galvanic battery, while its secondary coil is connected to line in the well-known manner. The various parts are electrically connected in the ordinary way well understood in the art, and the instrument operates after the manner of any contact telephone or microphone. The transmission of sounds is, however, accomplished with great distinctness and volume of tone, and the instrument will operate for an indefinite period without adjustment. The carbonised sheets, G G, may be of any desired number, and may be supported after any suitable plan. They are made by carbonising thin sheets of paper, cardboard, or other suitable material after the manner employed in forming the carbon strips of incandescent electric lamps, or in any other suitable manner.

392. "Obtaining light by electricity, &c." W. P. Thompson. (A communication from abroad by the Union Electric Manufacturing Company, of New York.) Dated January 26. 6d. Relates to the electric regulator, described in the number of this Journal for July 29th, page 66.

2416. "Electric batteries." H. H. Lake. (A communication from abroad by J. B. Wallace, of America.) Dated May 22. 6d. The object of the said invention is to construct a battery in which the largest carbon surface may be provided in the smallest space, and in the nearest or most uniform relation to the zinc; and the said invention comprises a glass or equivalent non-conducting covering plate for the battery jar, having a central opening to receive the zinc, and a series of openings around the central opening, combined with a metallic plate resting on the top of the glass cover and having openings corresponding with the openings which surround the central opening, each of the said openings being constructed to receive and hold a "carbon" (that is to say, a rod or piece of carbon) introduced through the openings in the glass cover, and so as to make an electrical connection between all of the carbons, and a connection for one wire with the central zinc independently of the carbon connecting plate, and the said carbon connecting plate being fitted for connection with the other wire.

DISCLAIMER.

The Edison Electric Light Company (Limited). "Systems of conductors for the distribution of electricity, &c." No. 3880. 1880.

CITY NOTES.

Old Broad Street.

THE NATIONAL TELEPHONE COMPANY (LIMITED).

The report of the directors for the year ending 30th June, 1882, states that a reference to the capital account will show the amount expended to 30th June. The directors beg to remind the shareholders that this company took over the businesses of several others, especially in Glasgow, Edinburgh, and Belfast, and has had to amalgamate their various systems. The outlay caused by this amalgamation has been considerable, but it has enabled the company to make important reductions in the staff and expenses. The various exchanges are now in good working order and the service offered to the public in all respects satisfactory. The gross revenue of the company at the 30th of June, 1881, was at the rate of £15,050 19s. 9d. per annum; at the end of the month of June this year, £26,996 3s. 10d., being an increase of 80 per cent. The net profits, after allowing for interest at the rate of 5 per cent. upon calls paid in advance, are £4,217 13s. 2d., which will enable the company to pay the preference shareholders 6 per cent. and to carry over £144 9s. 8d. The amount of rentals and subscriptions credited to the year was £19,243 10s. 11d., and the amount carried forward as gross revenue available for the current year £15,643 5s. 6d. The revenue is steadily increasing, at a higher ratio than the expenditure, and the directors anticipate a much larger profit during the current year. The company have twenty-six exchange licences from the Postmaster-General. The stations for which these licences are held are divided into those completed and contributing to the profits of the company, and those in course of construction, and drawing for their support from capital. There are now nine stations of the former kind, and it is the anticipation of the board that most of the new stations will be added to the self-sustaining list during the current year. The private wire business of the company is also steadily increasing.

Your directors are happy to be able to report that the United Company's defence of its patents in the courts of England and Scotland has been decisive and successful, making good its claim to the possession of the master patents for both transmitter and receiver. They have also pleasure in reporting to the shareholders that the Post-office officials throughout the company's districts act with consideration and courtesy in all their relations with its staff, and that so far as is consistent with the lines laid down by the Postmaster-General, the Department manifests a disposition to avoid placing unnecessary difficulties in the way of the operations of the company. The Postmaster-General has decided to grant exchange licences to responsible parties complying with certain specified conditions. Your directors do not apprehend that this decision will embarrass the transactions of the company, or tell against its prosperity. So long as the United Company's patents are maintained, and equally useful inventions not infringing them remain undiscovered, the decision of the Postmaster-General will not expose the company to legal or serious competition. Practically the company remains in the same position as regards exchange rivalry as if the Postmaster-General had not succeeded in establishing his right of monopoly in the public telegraph system.

On Friday the 18th instant the second annual ordinary general meeting of the shareholders of the above-named company was held at 11, Queen Victoria Street, under the presidency of Col. R. Raynsford Jackson, chairman of the company.

The secretary, Mr. W. B. Campbell, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have all received the directors' report; do you wish to hear it read, or will you take it as read?

The report having been taken as read, the Chairman continued: Gentlemen, I have to move that the report of the directors be accepted and confirmed by the shareholders. It is not my intention to dwell at any great length upon the position and prospects of the company. They are sufficiently, I think, indicated in the balance-sheet and in the report. You will see that the company's income for last year—or rather its revenue at the end of the last year—had reached within a small fraction of £27,000; then the profits for the year were £4,217 15s. 2d., which has enabled the directors to declare a dividend upon the preference shares of 6 per cent. and to carry forward a balance of £144 9s. 8d. One feature in the position of the company, which I think will be regarded as favourable, is that we carry forward £15,643 5s. 5d. towards the gross revenue of the current year. The company's business is divided into two kinds. There is the private wire business, which is entirely independent of the control of the Post-office, for which we do not require the Postmaster-General's licence. That business is on the increase, and I have no doubt that in the course of the current year and in future years it will receive a very large development. For the exchange business we require the Postmaster-General's licence, and it has been the policy of the Postmaster-General up to recently not to grant licences to more than one company in one town. I do not mean to say that there has been no exception to that rule, because in Dundee two existing telephone companies were granted licences. But the Postmaster-General has resolved to alter that rule that there should not be rival telephone companies in one town, and to allow responsible parties applying for licences to the Department to enter into rivalry for the telephone business, for the exchange and branch of the telephone business. This company is under no apprehension whatever as to the consequences of the competition which may arise from the decision which I have just mentioned of the Postmaster-General. In the first place, the company's business is based to a certain extent upon the exclusive license it holds from the United Telephone Company to use its telephones, to act under its patents, and as the United Telephone Company has with great spirit defended its practical and legal possession of the master patents which control the telephone business, the Postmaster-General's licence will not be of any great value to any rivalry. Unless a company enters into the exchange business with full possession of telephones it is practically out of the field. Therefore we do not fear competition. There is another and stronger reason why I do not think we have much to fear from competition of that character, that is that we have the Postmaster-General's licence to establish exchanges in many of the most important towns in the United Kingdom. We have already established exchanges that are giving a good and satisfactory and cheap service, and therefore we do not think that any competitor would have very much chance of successfully taking us in in any way in those places where we have established. The Postmaster-General, in a speech which he made in the House of Commons last Saturday has, whilst indicating his change of policy, made some remarks which, I think, are deserving of attention of all who are interested in the telephonic enterprise. He says that if the private telephone companies do the telephone business better than the Post-office, the Department would be delighted to have all the telephone business of the country conducted by private companies. He says later, if on the other hand it was proved that the business was done better by the Government than by the companies, the Government would have beaten the companies in the open field of competition, and occupy the ground without any question of purchase arising. Now the Postmaster-General is a man of logical mind, who weighs most minutely all his utterances before he puts them into speech before the House of Commons; and I think we may fairly conclude that he has thoroughly made up his mind before making this speech, and we may regard it as indicating truly his purpose. If therefore, he is prepared to welcome the development of the private telephone business, if he will be quite satisfied should the telephone companies beat the Post-office in fair competition, if he is prepared that the competition shall be a fair one, then I think that we have very little to apprehend from the competition of the Post-office; and I am quite convinced that so long as the present Postmaster-General is in office we shall only be opposed by fair competition from the Department. The Department has some advantages over a private company. It is in the position of having a very experienced staff. It has the advantage of being able to rest upon Acts of Parliament. It has also behind it the national purse. On the other hand the private companies have advantages of another kind, upon which they may rely with confidence. They have more elasticity of action; they are better able to secure large and generous support in the various localities; they have representatives of influence and importance in every district where they do business on their board of directors; and they are assisted by local boards and influential gentlemen in the towns where they do business, aiding to carry forward the business of the company. I think the National Telephone Company, constituted as it is and relying as it does on the absolute fairness of the Post-office department—I think that, bearing all these things in mind, the National Telephone Company may rest perfectly satisfied upon the basis upon which its business rests. I have to point out to the shareholders that there has been a loss during the current year in the trunk business of the company, and it may be necessary that I should explain what the character of that business is. When the Postmaster-General agreed to grant exchange licences to the various companies, he determined to keep the trunk business, that is the telephonic business between town and town, because he apprehended that if he did not the Post-ffice would lose very considerably in its postal telegraph revenue. After representations made to him he agreed that the Post-office should itself erect communications between our central exchanges in different towns. For example, the Postmaster-General has given us communication between Leeds and Bradford by a wire erected by the Post-office, but the terms upon which that privilege was granted us was upon terms that we should pay the Postmaster-General for eight subscribers, whether we obtained eight or not, and we have, in order to develop the telephonic enterprise in our various districts, run the risk of paying the Postmaster-General for a trunk wire, without having in the first instance secured eight subscribers. In some places we have only three subscribers where we have paid for eight. You will say, perhaps, that it was unwise for the company to have agreed with the Postmaster-General for the erection of these wires without having first secured the number of subscribers required by the Postmaster-General. It was, however, thought that it was necessary in the public interest and for the sake of developing the telephonic enterprise to run some risk, and in Yorkshire we ran the risk of coupling up the various towns in which we are interested, and agreeing to pay the Postmaster-General for nine different trunk wires. One effect of the course we have pursued is that the *Leeds Mercury* has become a subscriber to every one of our wires and to every one of our exchanges, and it is thus enabled to hold communication with its agents in Yorkshire a minute or two before going to press. Now, had we not run some risk of incurring some loss in adopting the trunk system the *Leeds Mercury* would not have been able to do that, and the force of its example on the telephonic enterprise would have been lost. I have an idea that there will be before long a change in the decision of the Department with regard to the trunk system. The inclination of the Postmaster-General and of the Post-office is to feel its way, and as it discovers that the alteration is beneficial to the public and the companies, without being detrimental to the interests of the Department, it is disposed to make changes which seem to be indicated as wise by the circumstances. I have great confidence that before we next meet the shareholders at an annual meeting I shall be able to announce that the trunk system is on a better footing. I am sure we should be, if we were as free with the trunk system as with the exchange. I have thought it necessary to enter into these explanations for two reasons, one that the shareholders may understand our position in this important matter, and that our subscribers may understand that we are giving them this service at a loss to the company. There is nothing further of moment that it is necessary to bring before the shareholders. I think they will be satisfied with the progress that the company has made, and I feel confident we shall be able to put before you another year a better and more favourable report, showing a larger balance on the year, and I have great confidence in the success of our enterprise. I may, however, return to the Post-office in order to refer to a matter of the Postmaster-General's, which, I think, it is well that I should make reference to. The Postmaster-General is apprehensive lest the idea that the Government intends taking over the telephone companies should lead to speculation in the shares, and thus undoubtedly enhance their value. I must say that, for this company, I learn with great satisfaction that the Postmaster-General has no idea of purchasing the telephone companies. When the Postmaster-General granted to us the exchange licences, he reserved to himself the right to take over the companies at certain periods upon valuations based upon certain principles. I think he proposed to take over the exchanges in 1890. If I could put him off till 1990 I should be glad (laughter). Therefore I learn that it is not the intention of the Postmaster-General to buy up the telephone companies. We ask only to be left free to enter into competition with the Post-office and other telephone companies, and we shall then have the fruit of our enterprise without the risk of having it taken over by the Government. I beg to move the adoption of the directors' report by the shareholders.

Mr. W. A. Smith said he rose to second the adoption of the report, but after the Chairman's very exhaustive statement, he did not think there was very much left for him to say. He could only heartily endorse all that he had said. He should like to point out to them one of the best features in the report. It was called the second annual meeting, but it really was the first, for their first annual meeting was almost a statutory meeting, as it was held very shortly after the formation of the company. In the brief space of one year, then, they had more than doubled their revenue. He did not require to point out to them the good point that was in the balance-sheet, because there were many charges fixed, or practically fixed. If their revenue went on in future years as it had done in the past the result could not fail to be highly satisfactory to the shareholders.

The proposition was then put by the Chairman and carried unanimously.

The re-election of the following retiring members of the board, Messrs. Jeremiah Garnett, John Bruce, and W. A. Smith was proposed by the Chairman, and having been duly seconded they were accordingly declared members of the board.

The Chairman also proposed the re-election of the auditors of the company, Messrs. Quilter, Ball & Co., which, having been seconded by Mr. W. A. Smith, was declared carried.

Mr. F. F. Begg (Edinburgh), in proposing a vote of thanks to the chairman and directors, said they had listened with pleasure to his exposition of the position of the company. He thought Colonel Jackson had shown them very clearly that he had a thorough grasp of the whole subject, and did not neglect any opportunity of advancing the interest of the company. But there was one matter upon which he did not enter, and to which he should like to refer. They might suppose that in making up a report the figures were made up from theoretrical knowledge, but he knew of his own knowledge that Colonel Jackson had made repeated visits to all the centres of the company during the year. He had gone as far north, he believed, as Aberdeen, certainly to Dundee. In fact, he had done the work of a general manager. He would be the last, he knew, to take all the credit to himself, for he was surrounded by a board of directors who seconded his efforts to the best of their power. He would, therefore, move that the thanks of the meeting be given to the chairman and directors.

Mr. C. J. Bell seconded.

The Chairman briefly returned thanks for himself and his colleagues. The board, he said, were representative men in their respective districts; they were men of energy and business, and had been selected for their local influence and business capacity.

The proceedings then terminated.

THE SOUTH EASTERN BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Thursday afternoon an extraordinary general meeting of the members of this company was held at the Cannon Street Hotel, under the presidency of Sir Michael Kennedy, for the purpose, if thought proper, of confirming the following special resolutions modifying the Articles of Association, passed at the extraordinary general meeting of the company held on the 9th inst., viz.:—"That the Articles of Association of the company be, and the same hereby are, altered as follows:—(1) By the insertion of the following words at the end of Article 4: 'Provided always that no share shall be issued at a discount without the sanction of a general meeting;' (2) by the alteration in Articles 81 and 89 of '1886,' therein mentioned, to '1884.' (3) By the omission of Articles 85 and 100."

There being just a quorum of shareholders present,

The Secretary, Mr. Alfred Jermyn, having read the notice convening the meeting,

The Chairman said: Gentlemen, we have met here only for the formal purpose of confirming the resolution which we passed at our last special meeting. There is no other business to be done at this meeting, and I need not address you at any length upon this matter. I merely propose the resolution which has been read to you, and I suppose you will take it as read?

Mr. Fry (a Director): I will second that.

The Chairman then put the resolution to the meeting, and it was carried unanimously.

PROVINCIAL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

SIR MICHAEL KENNEDY presided on Thursday over an extraordinary general meeting of the members of this company, held at Cannon Street Hotel, for the purpose, if thought proper, of confirming the following special resolutions, modifying the Articles of Association, passed at the extraordinary general meeting of the company held on the 9th inst., viz.:—"That the Articles of Association of the company be, and the same are hereby, altered as follows:—(1) By the insertion of the following words at the end of Article 4:—'Provided always that no share shall be issued at a discount without the sanction of a general meeting.' (2) By the alteration in Articles 81 and 89 of '1886,' therein mentioned, to '1884.' (3) By the omission of Articles 85 and 100."

The notice convening the meeting having been read by the Secretary, Mr. Alfred Jermyn,

The Chairman said: Gentlemen, our meeting is very special, and I think will be very brief. It is merely called that I should move the resolution which you have heard read by the secretary, which is confirmatory of the resolution passed on the occasion of the last meeting. I beg to move the resolution which has been read to you by the secretary.

Mr. Fry (a Director): And I beg to second it.

The resolution having been put to the meeting was carried unanimously, and the proceedings terminated.

BRUSH MIDLAND ELECTRIC LIGHT AND POWER COMPANY, LIMITED.—The directors have elected Mr. R. H. Glyn as chairman.

LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY.—The letters of allotment of this company have been ·ted.

WESTERN UNION TELEGRAPH COMPANY.—Messrs. Morton, Rose and Company notify the payment on September 1 of the interest due on the bonds of this company's Six per Cent. Sterling Loan.

BIRMINGHAM MUSICAL FESTIVAL.—There is to be a somewhat extensive installation of Electric Light at this festival, the work being undertaken by Mr. Crompton, in conjunction with Messrs. Winfield & Co. Twelve Bürgin machines are to be used, driven by a 120 horse-power engine; these to be stationed about 200 to 300 yards away from the hall.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Aug. 23.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	11⅝-12⅛	12 7/16.12⅛, 11 15/16.12.11⅞, ⅞.12 3/16.⅛.11⅞ xd.
		Do. Do.	10	25 - 30	28.7½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	⅞- 1⅛	1⅛
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1⅛- 1⅜	
25,000	5	Great Western Electric Light & Power Co.	2½	1 - 1⅛	1⅛.1
24,980	5	Hammond Electric Light & Power Supply Co.	2½	6¾- 7¼	7 3/16.7⅛.6⅞. 7 3/16
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅜- ⅝	
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1½- 2	
100,000	5	Swan United Electric Light Co., Limited	2	1⅛- 1⅜	1¼
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49½- 50½	50¼.50
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until {	100	79½- 80½	80.79¾
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. {	100	19½- 20½	20
130,000	10	Brazilian Submarine, Limited	10	11⅛- 11⅝	
16,000	10	Cuba, Limited	10	9½- 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15 - 16	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11¾ xd
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10½- 10⅞	10⅝.9/16.½
70,000	10	Do. 6 per cent. Preference	10	12¾- 13	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅛- 11⅝	11⅜ ¼
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	104 -107	107
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	100 -103	
345,700*l.*	100	Do. do. do. To Bearer	100	100 -103	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	10
163,390	10	Globe Telegraph and Trust, Limited	10	6¼- 6¾	
163,209	10	Do. 6 per cent. Preference	10	12¾- 13	
125,000	10	Great Northern	10	12¼- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	27
100,000	100	Do. 6 per cent. Debentures, 1896	100	101 -105	
17,000	25	Indo-European, Limited	25	29 - 30	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	2 - 2½	2¼
8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	255 -265	xd.
58,225	1	Do. Scrip	1	2⅛- 2⅜	
4,200	Cert.	Submarine Cables Trust	100	98 -103	
37,350	12	Telegraph Construction and Maintenance	12	27½- 28½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛- 1⅜	1 5/16
30,000	10	West Coast of America, Limited	10	4¾- 5¼	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	6¾- 7¼	6⅞
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	1½- 2	1 13/16.¾
34,563	10	Do. 6 per cent. 1st Preference	10	8½- 9	8¾
4,669	10	Do. 6 do. 2nd do.	10	6¾- 7¼	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅛- 1⅜	1 3/16
300,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	⅜- ⅝	½
100,000	5	United Telephone Co.	5	9¼- 9¾	9⅝.½.⅝ xd.

TRAFFIC RECEIPTS.

The Eastern Telegraph Company. The traffic receipts for July were £31,608, against £33,171 in the same month of 1881.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the five weeks ending 21st and 28th July and 4th, 11th and 18th August, 1882, were £1,623, £1,882, and £1,661, £1,718, £1,752, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

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Electrical Review.

Vol. XI.—No. 249.

ASSOCIATION FRANÇAISE POUR L'AVANCEMENT DES SCIENCES.

(*From our own Correspondent.*)

ELEVENTH SESSION.

August 24th to 31st, held at La Rochelle.

General Opening Sitting.

The eleventh meeting of the "Association Française pour l'Avancement des Sciences" was opened on August 24th, 1882, at half-past two o'clock p.m., under the presidency of M. Janssen, a member of the institute.

M. Janssen thanked La Rochelle for its sympathetic reception and called attention to the gratitude which it owes to one of its members, M. Brunet, a wealthy merchant of the French Antilles, lately deceased, who left a considerable fortune to the association, a fortune of which it will make the best use in the interests of the progress of science.

According to custom, M. Janssen, who has devoted all his time and all his knowledge to the study of physical astronomy, took for the subject of his speech: "The Condition of Physical Astronomy." He showed how this science, purely descriptive at its commencement, soon developed into celestial mechanics and tends now to become, with the aid of lenses, of spectrum analysis, and of photography, a physical science. He showed what advantages can be derived from the new photographic processes, which, owing to their exquisite sensibility, enable the sun to be photographed in one hundred thousandth part of a second, and predicted that before long the gelatine plate would become the veritable retina of the *savant*.

After the remarkable speech of M. Janssen, of which we can only indicate the principal points in a review devoted specially to the progress of electricity, M. S. Dor, Mayor of La Rochelle, welcomed the members of the association, and pointed out the numerous subjects of study which could be found in the department of La Charente-Inférieure.

M. Emile Trélat, Professor at the Conservatoire des Arts et Métiers, general secretary of the association, then alluded to the history of La Rochelle; he touched upon the homage due to deceased members, the honours accorded to a large number of the members of the association, and described the salient features of the tenth session, held at Algiers in the spring of the year 1881.

M. G. Masson, treasurer, then gave a report of the increasing prosperity of the financial condition of the association, which numbers at present more than 4,000 members. After this speech the meeting concluded, and the members met in their respective sections to proceed to the nomination of offices, and to fix the order of the section sittings.

Section Sittings.

The association is divided into four groups; the first devoted to mathematical science, the second to physical and chemical science, the third to natural science, and the fourth to economic science. These groups are themselves sub-divided into sections to the number of fifteen. We will only give account here of the labours of the fifth section—Physics—which holds its sittings in the physical laboratory of the Lycée de La Rochelle.

PHYSICAL SECTION.

Sitting of the 24th of August.

President—M. Lallemand, doyen de la Faculté des Sciences de Poitiers.

Secretary—M. Leblond, professor of the torpedo school at Boyardville.

The members of this section, very few in number, at the first sitting separated, fixing the order of procedure, which it is useless to give here, since we shall devote an analysis, more or less detailed, to each of the electrical subjects treated of in each sitting.

Sitting of the 25th of August.

NEW ELECTRO-DYNAMIC BALANCE.

(*For figure see next page.*)

By M. Debrun, Professor at the Lycée de Pau.

The inventor sought to construct an instrument at once easily worked, sensitive, and exact. The apparatus is composed of a pair of fixed bobbins and a pair of movable bobbins, placed at both ends of a horizontal beam. The current to be measured traverses these four bobbins, arranged in circuit in such a manner that the two fixed bobbins repel the movable bobbins placed upon the beam. To protect the system from the action of terrestrial magnetism the beam is placed perpendicularly to the plane of the magnetic meridian. The beam supports two scale-pans, intended to hold the weights, which give equilibrium to the system. The method consists of balancing the dynamic action of the current by weights, until the beam recovers its equilibrium, and the spirals of the bobbins are at the same relative distance asunder.

To avoid the use of weights, which is inconvenient, M. Debrun combined a hydraulic *compensator*, which replaces them. Under one of the scale-pans is fixed a platinum cylinder, dipping half-way into water.

By altering the height of the liquid the pressure is altered. Knowing the diameter of the platinum wire, and the variation of the level of the liquid, one easily deduces the value of the pressure. M. Debrun increases the sensitiveness of the apparatus by making use of a large cylindrical vase, in communication with a tube and a narrow graduated gauge. Equilibrium is restored by forcing the water backwards or forwards by the aid of an india-rubber bulb, worked by a screw and fixed to the end of it; thus readings are more easily and more exactly taken upon a graduated scale, occupying the length of the gauge. For accurate experiments, M. Debrun brings the balance always to the same position by providing the extremity of the needle of the balance with a net formed of spider's web, and by making use of a micrometer microscope. It is with an apparatus of this kind, divided for the purpose, that M. Debrun has examined the electrical discharges produced by surfaces of mercury vibrating in liquid conductors.

For intense currents, such as those employed for the electric light, M. Debrun replaces the hydrostatic pressure by a spiral spring, which is stretched more or less by means of a graduated screw.

RESEARCHES UPON THE PHOTOMETRIC COMPARISON OF VARIOUSLY COLOURED SOURCES.

Paper by MM. Macé de Lépinay and N. Nicati, read by M. Marcel Brillouin.

This question, apparently foreign to the subject which we are treating, is nevertheless directly attached to it, and is especially interesting to electricians who are in search of a simple, and above all, exact photometric process.

Two quantities of light may be considered equal when they illuminate the same colourless object (black upon a white ground, such as printed characters) placed always at the same distance from the same observer, and make him perceive the details of it with the same clearness, that is to say, when both quantities of light present the same clearness of outline.

We can, besides, consider two quantities of light as equal when they illuminate two colourless surfaces (white) and these surfaces appear equally illuminated; for example, in the Rumford photometer, when they give two shadows of the same intensity.

Unfortunately, it is difficult to appreciate the equality of clearness of two neighbouring surfaces differently coloured—for example, one blue and the other yellow. It is necessary in such a case to limit considerably the illuminated surfaces, as the smaller a surface is the less can the eye estimate its colouring.

The two methods above, based, one upon clearness of outline, the other upon the equality of illumination of two neighbouring surfaces,

The proposition was then put by the Chairman and carried unanimously.

The re-election of the following retiring members of the board, Messrs. Jeremiah Garnett, John Bruce, and W. A. Smith was proposed by the Chairman, and having been duly seconded they were accordingly declared members of the board.

The Chairman also proposed the re-election of the auditors of the company, Messrs. Quilter, Ball & Co., which, having been seconded by Mr. W. A. Smith, was declared carried.

Mr. F. F. Begg (Edinburgh), in proposing a vote of thanks to the chairman and directors, said they had listened with pleasure to his exposition of the position of the company. He thought Colonel Jackson had shown them very clearly that he had a thorough grasp of the whole subject, and did not neglect any opportunity of advancing the interest of the company. But there was one matter upon which he did not enter, and to which he should like to refer. They might suppose that in making up a report the figures were made up from theoretrical knowledge, but he knew of his own knowledge that Colonel Jackson had made repeated visits to all the centres of the company during the year. He had gone as far north, he believed, as Aberdeen, certainly to Dundee. In fact, he had done the work of a general manager. He would be the last, he knew, to take all the credit to himself, for he was surrounded by a board of directors who seconded his efforts to the best of their power. He would, therefore, move that the thanks of the meeting be given to the chairman and directors.

Mr. C. J. Bell seconded.

The Chairman briefly returned thanks for himself and his colleagues. The board, he said, were representative men in their respective districts; they were men of energy and business, and had been selected for their local influence and business capacity.

The proceedings then terminated.

THE SOUTH EASTERN BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

On Thursday afternoon an extraordinary general meeting of the members of this company was held at the Cannon Street Hotel, under the presidency of Sir Michael Kennedy, for the purpose, if thought proper, of confirming the following special resolutions modifying the Articles of Association, passed at the extraordinary general meeting of the company held on the 9th inst., viz.:—"That the Articles of Association of the company be, and the same hereby are, altered as follows:—(1) By the insertion of the following words at the end of Article 4: 'Provided always that no share shall be issued at a discount without the sanction of a general meeting;' (2) by the alteration in Articles 81 and 89 of '1886,' therein mentioned, to '1884.' (3) By the omission of Articles 85 and 100."

There being just a quorum of shareholders present,

The Secretary, Mr. Alfred Jermyn, having read the notice convening the meeting,

The Chairman said: Gentlemen, we have met here only for the formal purpose of confirming the resolution which we passed at our last special meeting. There is no other business to be done at this meeting, and I need not address you at any length upon this matter. I merely propose the resolution which has been read to you, and I suppose you will take it as read?

Mr. Fry (a Director): I will second that.

The Chairman then put the resolution to the meeting, and it was carried unanimously.

PROVINCIAL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

Sir Michael Kennedy presided on Thursday over an extraordinary general meeting of the members of this company, held at Cannon Street Hotel, for the purpose, if thought proper, of confirming the following special resolutions, modifying the Articles of Association, passed at the extraordinary general meeting of the company held on the 9th inst., viz.:—"That the Articles of Association of the company be, and the same are hereby, altered as follows:—(1) By the insertion of the following words at the end of Article 4:—'Provided always that no share shall be issued at a discount without the sanction of a general meeting.' (2) By the alteration in Articles 81 and 89 of '1886,' therein mentioned, to '1884.' (3) By the omission of Articles 85 and 100."

The notice convening the meeting having been read by the Secretary, Mr. Alfred Jermyn,

The Chairman said: Gentlemen, our meeting is very special, and I think will be very brief. It is merely called that I should move the resolution which you have heard read by the secretary, which is confirmatory of the resolution passed on the occasion of the last meeting. I beg to move the resolution which has been read to you by the secretary.

Mr. Fry (a Director): And I beg to second it.

The resolution having been put to the meeting was carried unanimously, and the proceedings terminated.

Brush Midland Electric Light and Power Company, Limited.—The directors have elected Mr. R. H. Glyn as chairman.

London and Globe Telephone and Maintenance Company.—The letters of allotment of this company have been posted.

Western Union Telegraph Company.—Messrs. Morton, Rose and Company notify the payment on September 1 of the interest due on the bonds of this company's Six per Cent. Sterling Loan.

Birmingham Musical Festival.—There is to be a somewhat extensive installation of Electric Light at the Festival, the work being undertaken by Mr. Crompton, in conjunction with Messrs. Winfield & Co. Twelve Bürgin machines are to be used, driven by a 120 horse-power engine; these to be stationed about 200 to 300 yards away from the hall.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Aug. 23.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	11½-12½	12 7/16-12⅝. 11⅞ 5/16-12-11⅞. ⅞-12 3/16-⅛-12⅛ xd.
		Do. Do.	10	25 - 30	26.7½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	⅞- 1⅛	1⅛
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1½- 1⅞	
25,000	5	Great Western Electric Light & Power Co.	2½	1 - 1⅛	1⅛.1
24,980	5	Hammond Electric Light & Power Supply Co.	2½	6½- 7½	7 1/16-7.½.6⅞-7 3/16
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅛- ⅜	
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1½- 2	
100,000	5	Swan United Electric Light Co., Limited	2	1½- 1⅞	1½
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	49½- 50½	50⅛.50
2,441,800*l*.	Stk.	Do. Preferred } Def'd. receiving no div until	100	79½- 80½	80.79⅞
2,441,800*l*.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19½- 20½	20
130,000	10	Brazilian Submarine, Limited	10	11¼- 11¾	
16,000	10	Cuba, Limited	10	9½- 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15 - 16	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11½ xd
100,000*l*.	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10½- 10¾	10⅝ 9/16-11
70,000	10	Do. 6 per cent. Preference	10	12½- 13	
232,000*l*.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	99 -102	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	100 -103	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½- 11¾	11⅝ 5/16
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	101 -107	107
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l*.	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	100 -103	
345,700*l*.	100	Do. do. do. To Bearer	100	100 -103	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	10
163,390	10	Globe Telegraph and Trust, Limited	10	6¼- 6¾	
163,209	10	Do. 6 per cent. Preference	10	12½- 13	
125,000	10	Great Northern	10	12¼- 12¾	
100,000*l*.	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	27
100,000	100	Do. 6 per cent. Debentures, 1896	100	101 -103	
17,000	25	Indo-European, Limited	25	29 - 30	
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8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	255 -265	xd.
58,225	1	Do. Scrip	1	2½- 2⅞	
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150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
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1,030,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	1½- 2	1 13/16-⅞
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4,669	10	Do. 6 do. 2nd do.	10	6½- 7½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1⅝	1 9/16
300,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	⅜- ⅝	½
100,000	5	United Telephone Co.	5	9½- 9⅞	9 11/16-¾-⅝ 11/16-⅝ xd.

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The associati[illegible] devoted to mathe[illegible]

[illegible] copper tube. [illegible] concentrically round the axle o, o'. [illegible] ng the weight P. [illegible] e magnet, bearing two knife edges upon its axis. [illegible] of this magnet is an iron tube, surrounded by [illegible] be, to which a rapid rotary motion is imparted. The [illegible] nduction tend to attract the magnet in the direction of the [illegible] on, and it is necessary, in order to maintain equilibrium, [illegible] alance this action by the aid of a counterpoise,* sus-

[illegible] d-indicator properly so called, the magnet, which has been properly [illegible] ed at a certain angle dependent on this speed, and it is this angle [illegible] of its determination.

[illegible]

President—M. [illegible] Sciences de P[illegible]

Secretary—[illegible] at Rochefort.

The members of [illegible] first sitting [illegible] it is useless [illegible] more or less [illegible] treated of in each sitting.

SITTING OF THE [illegible]

NEW ELECTRO[illegible] BALANCE.

By M. [illegible]

[illegible]

To avoid the use of weights [illegible] M. Debrun [illegible] combined a hydraulic [illegible] of the scale-pans is fixed a platinum [illegible] dipping half-way into water.

By altering the height of the liquid the pressure is altered. Knowing the diameter of the platinum wire and the variation of the level of the liquid, one easily deduces the value of the pressure. M. Debrun increases the sensitiveness of the apparatus by making use of a large cylinder [illegible] graduated gauge. [illegible] backwards or forwards by the aid of [illegible] by a screw and fixed to the end [illegible] and more exactly taken upon a graduated [illegible] of the gauge. For accurate experiments M. Debrun brings the balance always to the same point [illegible] the extremity of the needle of the balance with a [illegible] and by making use of a micrometer microscope. [illegible] an apparatus of this kind, divided for the purpose, that M. Debrun has examined the electrical discharges produced by surfaces of [illegible] vibrating in liquid conductors.

For intense currents, such as those employed for the electric light, M. Debrun replaces the hydrostatic pressure by a spiral spring, which is stretched more or less by means of a graduated screw.

RESEARCHES UPON THE PHOTOMETRIC COMPARISON OF VARIOUSLY COLOURED SOURCES.

Paper by MM. Macé de Lépinay and N. Nicati, read by M. Macé de Lépinay.

This question, apparently foreign to the subject which we are treating, is nevertheless directly attached to it, and is especially interesting to electricians who are in search of a simple, and above all, [illegible] metric process.

[illegible] of light may be considered equal when they illu[illegible] the me[illegible] a white ground [illegible] ingenious [illegible] the principle to [illegible] always at the same distance from the [illegible] the details of it with the same [illegible] tities of light present the [illegible] as equal when [illegible] surfaces [illegible] meter,

SITTING OF THE 28TH [illegible]

ELECTRICAL INCANDESCENT LAMP[illegible] OPEN AIR.

By M. Emile Reynier.

The process of incandescence in the open air, which [illegible] known in 1878, is now abandoned. Various causes bro[illegible]

are evidently equivalent when luminous sources of the same colour are being tested. For variously coloured lights, the experiments of M. Siemens and those of MM. Macé de Lepinay and Nicati prove that they are inapplicable.

Two quantities of light capable of giving two shadows of the same clearness, will not make equally distinct, black printed characters upon a white ground.

MM. Macé de Lepinay and Nicati have, therefore, undertaken some comparative experiments, and have established numerical relations which have led them to conclusions particularly interesting to electricians. We will reproduce them here.

It is quite evident that the principal object of public and private illumination is not to produce upon the eye a more or less intense sensation of light, but rather to enable us to distinguish what is round about us. Consequently, with equal illuminating power, there is evidently every advantage in the employment of a yellow illuminating source—intense gas jets or electric incandescent lamps—in preference to the employment of a source rich in blue rays, as is the electric arc.

This conclusion results from the fact that experiments made by both methods lead to results that correspond for all radiations *less* refrangible than greenish yellow, but that completely differ for radiations *more* refrangible.

Also, in order to characterise the practical value of a source of light, it is not sufficient to give its value in Carcels, a value deduced from the comparison of the shadows produced by these two sources, but there will be every advantage in determining at the same time the illuminating power of the source by a method deduced from clearness of outline. In this manner two numbers would be obtained which in some cases might be widely different, according to the nature of the source employed.

SITTING OF THE 26TH AUGUST, 1882.

LIGHT BICHROMATE OF POTASH BATTERY.

Result of the preliminary experiments performed by the aid of a dynamo-electric motor actuating an aerial screw.)

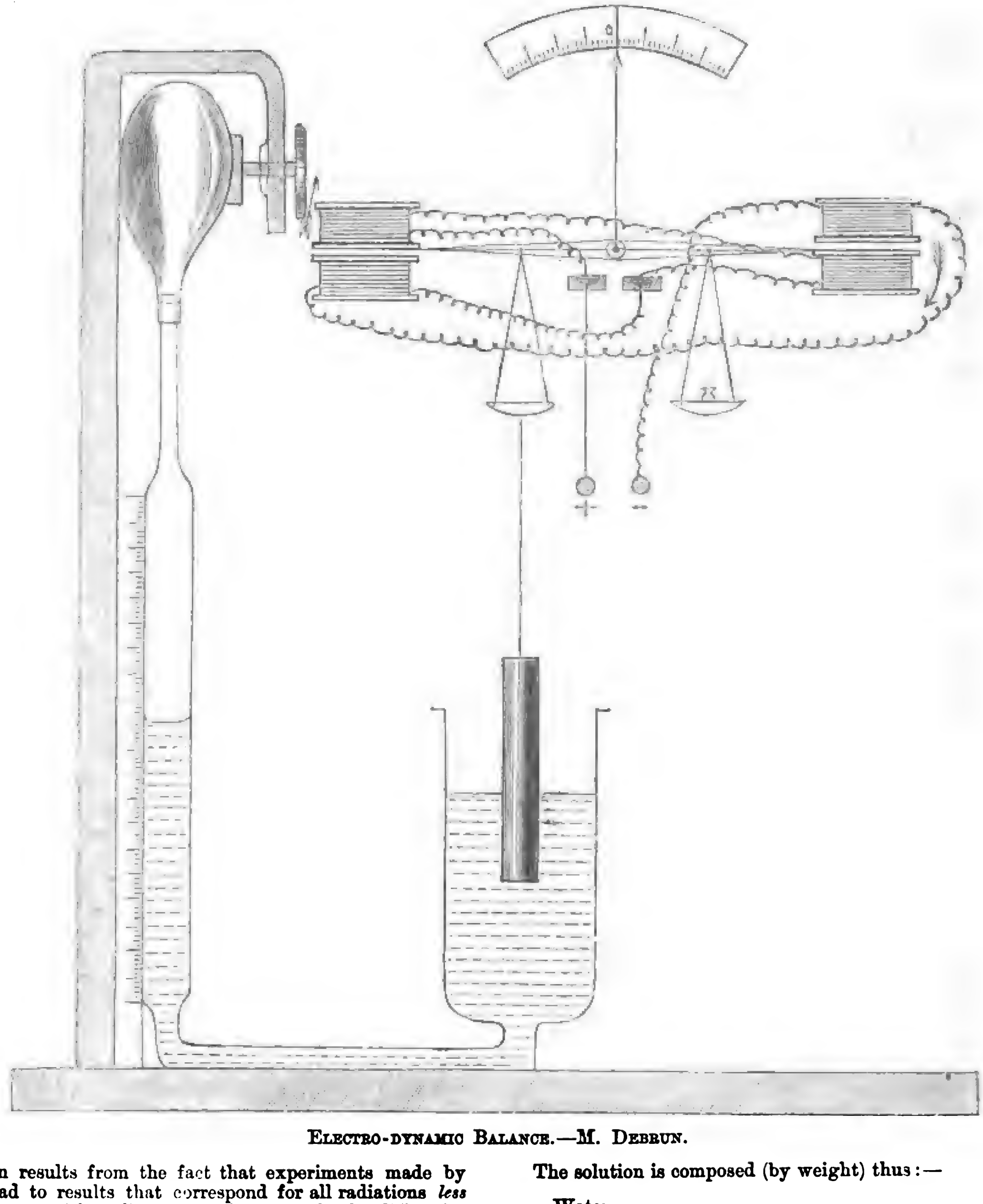
By M. GASTON TISSANDIER.

The writer proposed in his researches to realise the experiment made by M. Giffard in 1852 with a steam motor, making use of an aerial screw actuated by an electric motor. Its employment presents two advantages—absence of fire and constancy of weight. After having made experiments on a small scale with accumulators and bichromate of potash batteries on the model of M. Trouvé, and calculated that the bichromate batteries present greater constancy than is commonly supposed, M. Tissandier conceived the idea of the model which we shall describe, giving the results obtained from it.

Each element is composed of a parallelopipedical trough of ebonite, containing 10 plates of zinc alternated with 11 carbon plates. The weight of each element is expressed thus:—

	Grammes.
Zincs	1,200
Carbons	900
Ebonite vessel	860
Liquid (about four litres)	4,800
Accessories	200
Total	7,960

Or *eight* kilogrammes, in round numbers.



ELECTRO-DYNAMIC BALANCE.—M. DEBRUN.

The solution is composed (by weight) thus:—

	Parts.
Water	100
Bichromate of potash	16
Sulphuric acid	37

With the addition of a little bisulphate of mercury to maintain the amalgamation of the zincs. The great concentration of the solution diminishes the internal resistance of the element, increases its discharge per unit of time, and reduces the weight of water, which is a dead weight, to its minimum.

The constants of the element are:—

$$E = 2 \text{ volts.}$$
$$r = 0{\cdot}01 \text{ ohm.}$$

A battery of 18 elements in tension weighs 140 kilogrammes. [illegible] can supply upon an external circuit of 0·54 ohm resistance a c[illegible] of 50 ampères for about an hour and a half, and a usefu[illegible] force of 135 kilogrammètres per second, from which could [illegible] 100 kilogrammètres of effective work (1¼ horse-power [illegible] 90 minutes.

We will pass over the description of the screw [illegible] the motor.

The motor is a continuous current dynamo [illegible]

on the Siemens system, constructed and adapted specially for this purpose at the Siemens establishment at Paris, directed by M. Boistel.

All its parts, except the induced part, are of cast-steel, but they have been reduced to a minimum of weight and dimensions, for the machine, constructed to furnish 100 kilogrammètres with a current of 50 ampères, making 1,200 revolutions, only weighs 55 kilogrammes.

The battery and the machine, therefore, weigh no more than 200 kilogrammes; an elongated balloon of 1,000 cubic metres, 27 metres long and 9 metres diameter at the centre, is sufficient to support them. With a machine giving 100 kilogrammètres and a screw of 2·85 m. diameter, making 100 revolutions per second, M. Tissandier expects to obtain an average speed of 4 metres per second, which will allow him to deviate sensibly from the line of the wind, and even to direct himself in any direction in calm weather.

ON THE METHODS OF COMPARING THE CO-EFFICIENTS OF INDUCTION; CAUSES OF ERRORS, AND MEANS OF PREVENTING THEM.

By M. MARCEL BRILLOUIN.

The nature of this communication, of an order at once theoretical and experimental, does not admit of a succinct analysis, and could find no place here except with developments, which would lead us out of the course which we have traced for ourselves.

REGISTERING CAPILLARY ELECTROMETER.

By M. E. DEBRUN.

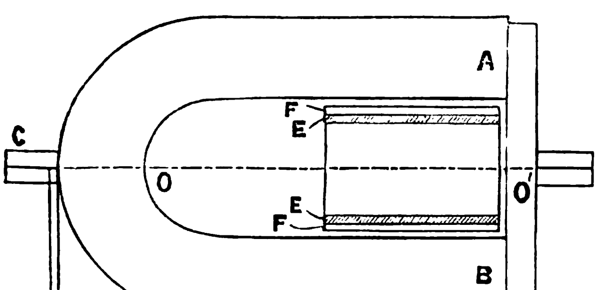
In certain investigations which demand an almost continuous observation of the difference of potential between two given points, it is very fatiguing to observe and record the variations of height of the column of mercury of the electrometer.

M. Debrun has combined, with the object of suppressing this fatigue, and of obtaining continuous and more precise results, a recording system, which is ingenious, but rather complicated. It would be impossible to make the mechanism understood without the assistance of a figure.

ELECTRO-MAGNETIC DETERMINATION OF THE MECHANICAL EQUIVALENT OF HEAT.

By M. MARCEL DEPREZ.

The experiments hitherto made to determine the mechanical equivalent of heat have given numbers which vary between 420 and 432. The errors arise chiefly from the imperfect process which serves to determine the labour expended. The method proposed by M. Marcel Deprez depends in principle upon a measurement of the effects of induction in the Foucault disc. To understand this method, it is necessary, in the first place, to remember the magnetic speed-indicator of M. Marcel Deprez. This apparatus is composed of



SPEED-INDICATOR.—MARCEL DEPREZ.

A, B. Horse-shoe magnet.
C, D. Knife edges.
E. Iron tube. F. Copper tube.
The two tubes turn concentrically round the axle O, O'.
L. Lever supporting the weight P.

m

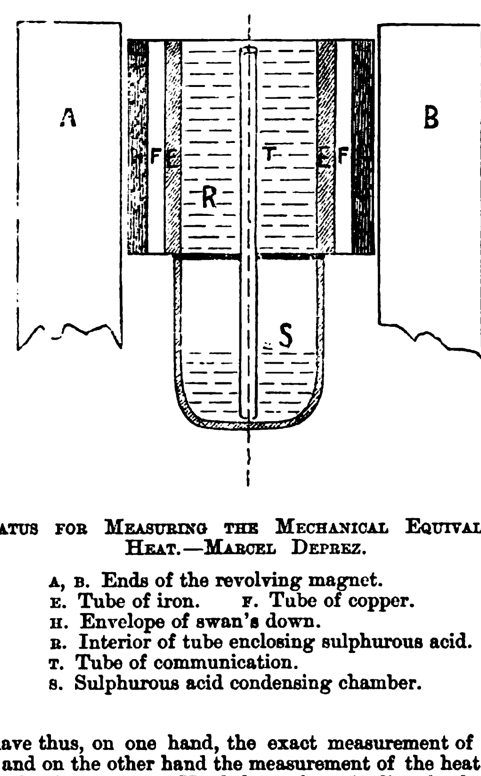
nomi a horizontal horse-shoe magnet, bearing two knife edges upon its axis. Between the poles of this magnet is an iron tube, surrounded by sittings. copper tube, to which a rapid rotary motion is imparted. The ...cts of induction tend to attract the magnet in the direction of the ...ry motion, and it is necessary, in order to maintain equilibrium, ...unterbalance this action by the aid of a counterpoise,* suspended at the extremity of a horizontal lever, perpendicular to the common axis of the magnet, and the revolving copper and iron tube.

Knowing the speed of rotation and the couple which equalises the inductive action, it is very easy to deduce therefrom the inductive energy absorbed by the system, energy which is transformed entirely into heat.

To obtain a constant speed, the copper and iron tube is set in motion by means of an electro-motor provided with a centrifugal interrupter, invented by M. Marcel Deprez. We can thus, and this is the preferable means, utilise the tendency to displacement of the magnet, under the influence of feeble variations of speed, to break or close the circuit of the electric motor which actuates the apparatus. The speed varies then only to a very small degree. The speed-indicator is therefore transformed into a Foucault disc, with a constant speed and of a peculiar form, in which the quantity of inductive energy, transformed into heat, is measured very exactly by means of the speed of rotation, and of the couple which equalises the magnet. It is important to observe that this method eliminates all passive resistances, only taking account of the inductive energy transformed into heat in the copper and iron tube. It remains now to measure the quantity of heat given out in the system in rotation.

To this end M. Marcel Deprez applies the principle of the sulphurous acid calorimeter of M. d'Arsonval. The apparatus designed for measurement comprises a movable magnet and a fixed copper and iron tube, that is to say, an arrangement the reverse of that for the speed-indicator. The interior of the fixed tube, closed at both extremities, is filled with sulphurous acid in communication by a small tube with an external reservoir. The evaporation of the sulphurous acid and its condensation in the external tube are effected by the most slight elevation of temperature. The volume of acid condensed in a given time indicates the number of calories furnished by the apparatus. Condensation occurring at the temperature of the surrounding air, there is no correction to make in this respect. In order that the feeble elevation of temperature of the tube of copper and iron may not produce any radiation and any loss of heat, this tube is enveloped in swan's down, which opposes radiation.

The tube being fixed and the magnet movable, the tube tends to be attracted by the magnet. The torsion couple is equalised by a platinum wire, the effect of which is measured, applying the laws of elasticity.



APPARATUS FOR MEASURING THE MECHANICAL EQUIVALENT OF HEAT.—MARCEL DEPREZ.

A, B. Ends of the revolving magnet.
E. Tube of iron. F. Tube of copper.
H. Envelope of swan's down.
R. Interior of tube enclosing sulphurous acid.
T. Tube of communication.
S. Sulphurous acid condensing chamber.

We have thus, on one hand, the exact measurement of inductive energy, and on the other hand the measurement of the heat liberated by this inductive energy. He deduces from it directly the value of the mechanical equivalent of heat, writing that the inductive energy in a given time, when the *régime* is established, is equal to the heat evolved deducted from the quantity of sulphurous acid condensed during the same time, multiplied by the mechanical equivalent of heat, the only unknown quantity in the problem. The apparatus is constructed with great accuracy, and gives the hope of determining the mechanical equivalent of heat as near as 1-1000 owing to the ingenious method of which M. Marcel Deprez has just presented the principle to the association.

SITTING OF THE 28TH AUGUST, 1882.

ELECTRICAL INCANDESCENT LAMPS ACTING IN THE OPEN AIR.

BY M. EMILE REYNIER.

The process of incandescence in the open air, which I made known in 1878, is now abandoned. Various causes brought

The associati ...e speed-indicator properly so called, the magnet, which has been properly ...nclined at a certain angle dependent on this speed, and it is this angle devoted to mathe ...mits of its determination.

this about; not to mention those of a technical order. I recognise that my old lamps have a rather low photometric effect; that certain of their parts are delicate, and call for attentions sometimes incompatible with the requirements of practice.

FIG. 1.

But these defects, connected with one system of lamp, and to the dispositions which have been given to it, are not inherent to the process of incandescence in the open air itself. I was therefore able to seek, with the same view, new systems, giving, like the old one, a white and fixed light, and in which the defects recognised in the old lamps will be eliminated or decreased. It is the results of these new researches which I wish to explain clearly.

I shall only illustrate by figures the principle of my old system (fig. 1) and its most usual form (fig. 2), to bring immediately to the fore the description of the unpublished details.

Second System.

With a given electric conductor, one can considerably increase its resistance by cutting it transversely in various places. The increase

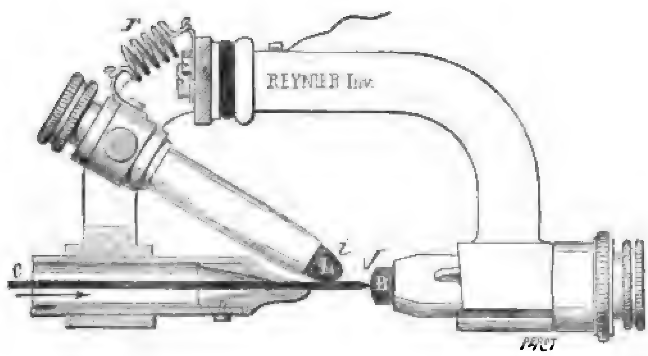


FIG. 2.

of resistance is more considerable in proportion as the sections are more numerous and smaller.

Fig. 3 shows a conductor of graphite composed of a certain number of superposed layers, moderately pressed together between two contacts.

FIG. 3.

FIG. 4.

Such a conductor, mounted in a transparent, hollow, and completely closed receptacle, would constitute a good electric lamp; but its construction gives rise to difficulties which have not been overcome.

In air the combustion of the incandescent carbon necessitates the renewal of the material of the luminous matter. This is how the difficulty may be surmounted.

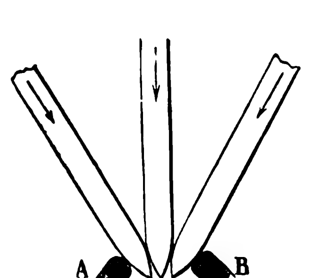


FIG. 5.

The dissected conductor is composed of the converging extremities of small rods of carbon, which come together between the two contacts, A and B (fig. 4), each rod is traversed, transversely and at its extremity only, by the electric current. With n carbons, one obtains $n + 1$ contacts. The renewal of the carbon as consumed is brought about by the continual progression of the carbons, which coincide, like the *voussoirs* of an arch, of which the contact pieces will be the piers.

The arrangement indicated in fig. 4 is only realisable with very thin carbons in the transverse direction; carbons of round or square section take a wolf's tooth form (fig. 5), which is unfavourable to the luminous effect of the apparatus, for the points relatively cold which stand out from the dissected conductor are the seat of a very important superfluous emission of heat.

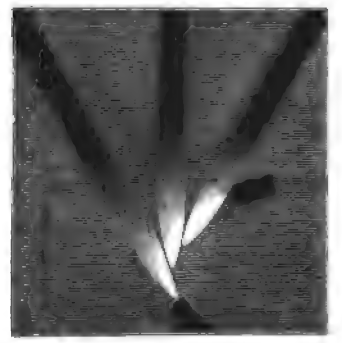


FIG. 6.

We have overcome this difficulty in the arrangement, fig. 6. The dissected conductor describes a broken line, and the current, traversing the end of each rod obliquely, leaves no point out of circuit. Fig. 7 represents an electric lamp constructed upon this principle. The carbons, guided between two pumice-stone plates, are respectively propelled towards the opening of the lamp by unequal weights, sliding in grooves made in a brass triangle. The insulated pieces, A and B, serve as stops and as terminal contacts.

This lamp acts well, but we must wait, to judge of it, until it is provided with carbons of a very

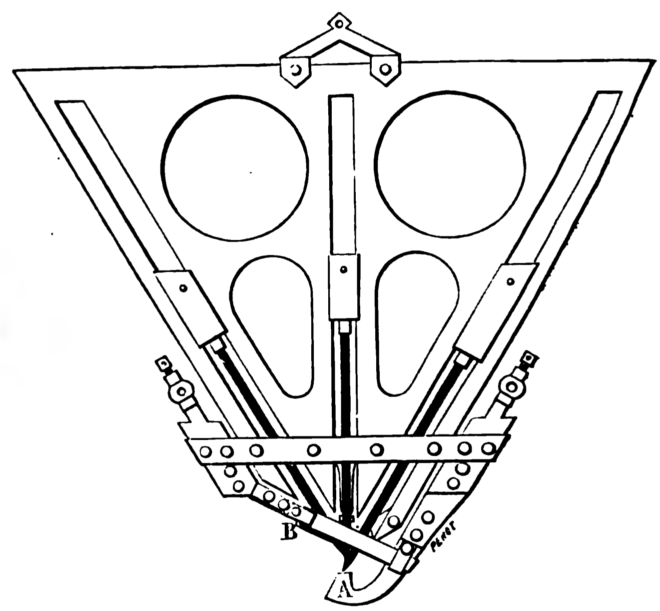


FIG. 7.

flattened section, which will allow of multiplication and of approximating the contacts, to simplify the lamp and diminish its size.

Provisionally, I prefer the following recent invention, which is more simple, less voluminous, and acting with any carbons whatever.

Third System.

I utilise here the thin form which we notice in the two preceding systems.

There are two rods of carbon made thinner at one end (fig 8); they are placed in the same plane, almost parallel to each other, and are approximated until they touch; their point of contact, x, will be

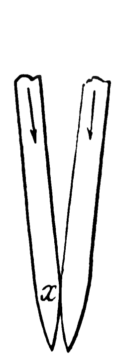


FIG. 8.

FIG. 9.

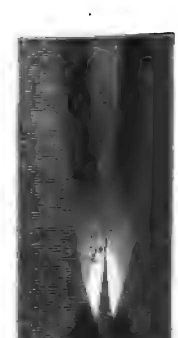


FIG. 10.

situated above the points, towards the base of the coning. The points being free, one can make them rest upon two contacts, A and B (fig. 9), and thus obtain an incandescent system in which the electric current

traverses successively, in the opposite direction, the two pointed ends, passing from one to the other by their lateral mutual contact.

To maintain the parts in this condition, notwithstanding the combustion of the points, it is necessary continuously to impel the carbons, in a longitudinal direction, and to give to the supporting contacts a suitable obliquity (fig. 10); the rods ought also to be guided in their common plane. Under these conditions, the pointed form is maintained; the carbons continue to impinge upon their respective contacts, and to touch each other at a certain distance above the points. Fig. 11 represents one practical form given to the apparatus. The carbons, A and B, are respectively impelled by weights, P and Q, sliding upon two metallic guides, C and D. The oblique contacts, E, F, are two sheets of copper, fixed upon bronze arcs, G, H. Two pairs of insulated clamps, I and J, connect the two halves of the lamp; the first pair is of wood, the second is of slate, and forms a slot, which guides the two carbons in their common plane.

The weights, P and Q, are insulated from the carbons which they impel, by ivory caps, *r* and *s*.

The electric current, entering by the terminal, K, follows the brass guide, C, the bend, G, the contact, E, goes up the pointed extremity of the carbon, A, passes over the contact, *x*, descends by the carbon end, B, and follows the contact, F, the bend, H, and the guide, D, to the terminal, L.

The two extreme contacts make little shadow; the middle contact causes no loss of heat or light, and usefully increases the total resistance of the lamp.

This combination of two very approximate incandescent points, and of three neighbouring contacts, procures a concentration of heat favourable to the photometric effect of the apparatus.

The experiments in progress will give, on this point, figures which will confirm the favourable impression produced by the first trials.

The apparatus is simple, easily manipulated, and of certain action; its narrow and symmetrical form allows of using it everywhere.

As to the necessity of renewing the carbons daily, it has been necessary, up to this day, to submit to it in all systems capable of giving *white* light with a good photometric effect.

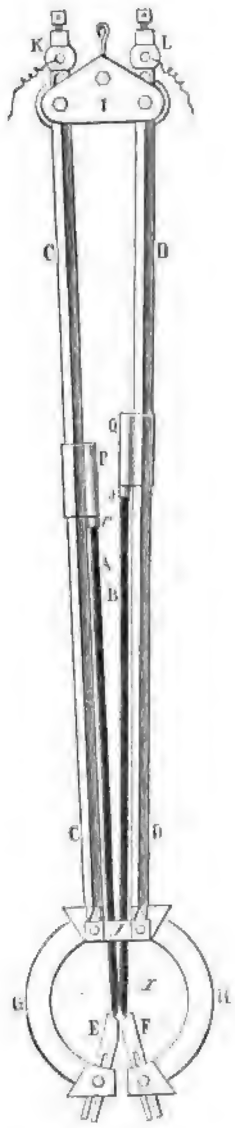


FIG. 11.

The most grave defect of my incandescent lamps is their too feeble resistance, which necessitates the employment of intense currents, the transmission of which is costly.

From this point of view, the third system, is superior to the first, but inferior to the second.

A DIFFERENTIAL ELECTRIC THERMOSCOPE.

By W. F. NOSWORTHY.

IT has of late frequently been pointed out to students and others that little real progress can be made in any branch of science from the cursory reading of a book; that by experiment alone can such subjects be successfully grappled with.

This is undoubtedly true; but it must be remembered that by far the greater portion of such persons are unable to attend lectures, join societies, or otherwise avail themselves of the facilities offered to those who have the good fortune to reside in London or other large city where these institutions exist, while the excessive cost of scientific apparatus, even of the most elementary nature (frequently exceeding many times the intrinsic value of the articles), forbids their procuring the necessary instruments wherewith to experiment at home.

This latter fact is undeniably a great obstacle to the progress of science, therefore whatever steps are taken tending to reduce the price of scientific apparatus generally will, I venture to say, be welcomed by all, and prove a material aid to science by increasing the number of workers in the field.

To persons engaged in the study of radiant heat, or even those who have occasionally to measure small differences of temperature, the possession of a thermopile is of paramount importance. The cost of this instrument is about £4 4s.

The object of the present communication is to call the attention of those interested to a simple arrangement which may with advantage replace the thermopile, and be constructed by any one at a cost not exceeding five shillings.

It has long been known that the electrical resistance of a wire varies with every change of temperature, the resistance increasing with a rise and diminishing with a fall of temperature. This fact forms the principle upon which the instrument about to be described is based.

Four coils of fine, silk-covered copper wire are joined up with a delicate galvanometer and a couple of Daniell's cells as a Wheatstone's bridge (fig. 1). If the resistances of the

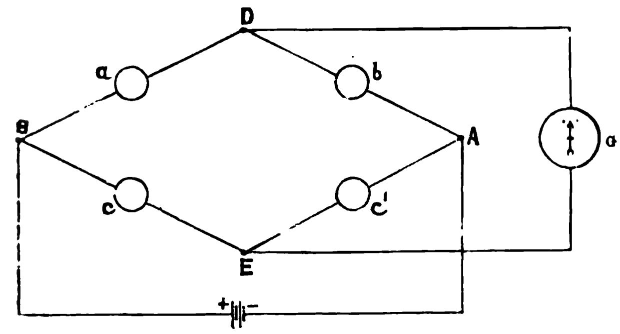


FIG. 1.

coils, *a*, *b*, c, c′, are equal and at the same temperature, the points, D and E, will be at the same potential; therefore no current will flow through the galvanometer, G.

Suppose, now, the temperature of one of the coils, c, for example, be raised, the resistance of that coil will be increased and the potential of the point, E, thereby reduced relatively

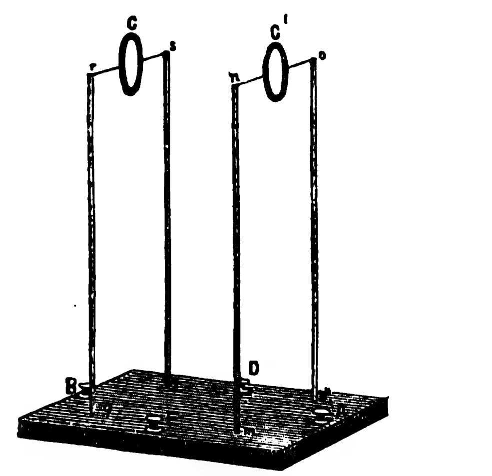


FIG. 2.

to that of D, consequently a current will flow through G in the direction from D to E, causing a deflection, say, to the left. On the other hand, if it be the temperature of c′ that is increased the potential of E will be raised above that of D, and the direction of the current through G reversed, the deflection in this case being to the right. If however the temperature of both c and c′ be increased or reduced by exactly equal amounts, no change will take place in the potential at E, and there will be no deflection of the galvanometer.

From what has now been stated fig. 2 will be readily understood.

The two coils, *a*, *b* (fig. 1), are embedded in the base of the instrument, while the coils, c, c′, are supported, as shown, by the four glass tubes, *m n*, *o p*, *q r*, *s t*, through which the connecting wires from the respective coils pass to the terminals on the base. The battery may be connected to the terminals, B, A, and the galvanometer to D, E, or *vice versâ*. Arranged thus, the instrument forms a differential thermoscope of great sensibility, and can be used in every case where the thermopile has hitherto been employed.

In the instrument represented by the drawing the four coils are composed of No. 40 silk-covered copper wire and

have a resistance of 20 B.A. units each. The coils, c, c′, are further coated with lampblack. The galvanometer used in connection therewith is an astatic mirror, of which a section having a resistance of 125 ohms has been employed.

It will be seen that the relation between the resistance of the galvanometer and coils is not such as to give the maximum sensibility to the arrangement, nevertheless the comparisons made between this instrument and a thermopile of forty-eight pairs of antimony-bismuth plates, having a resistance of 1·4 units, and joined up with an astatic reflecting galvanometer of 1·5 units resistance, specially constructed for use with the pile, are extremely satisfactory, for when a source of heat is placed equidistant from the two the galvanometer in connection with the thermoscope invariably gives the highest deflection, and is also the first to sink to zero when the source of heat is removed.

For those who have not the means of measuring the resistance, the coils may be made of equal lengths of wire. As, however, owing probably to mechanical defects in manufacture, two equal lengths of the same wire seldom have exactly the same resistance, it will be necessary to finally adjust the coils by adding or cutting off a small piece of the wire until the galvanometer shows no movement when the battery circuit is closed. Sufficient time should elapse between touching the coils and making this trial to allow the wire to assume the temperature of the atmosphere, otherwise the coil last touched will appear to have the greatest resistance.

Many improvements in the construction of the instrument will readily suggest themselves, the form shown in the figure has, however, answered all my requirements, indeed since its completion I have seldom used the thermopile.

CHASTER'S TELEPHONIC APPARATUS.

THIS arrangement, which is shown in general appearance by fig. 1, is the invention of Mr. J. E. Chaster. It is a very convenient and neat adaptation of an electro-magnetic telephone with a microphonic transmitter.

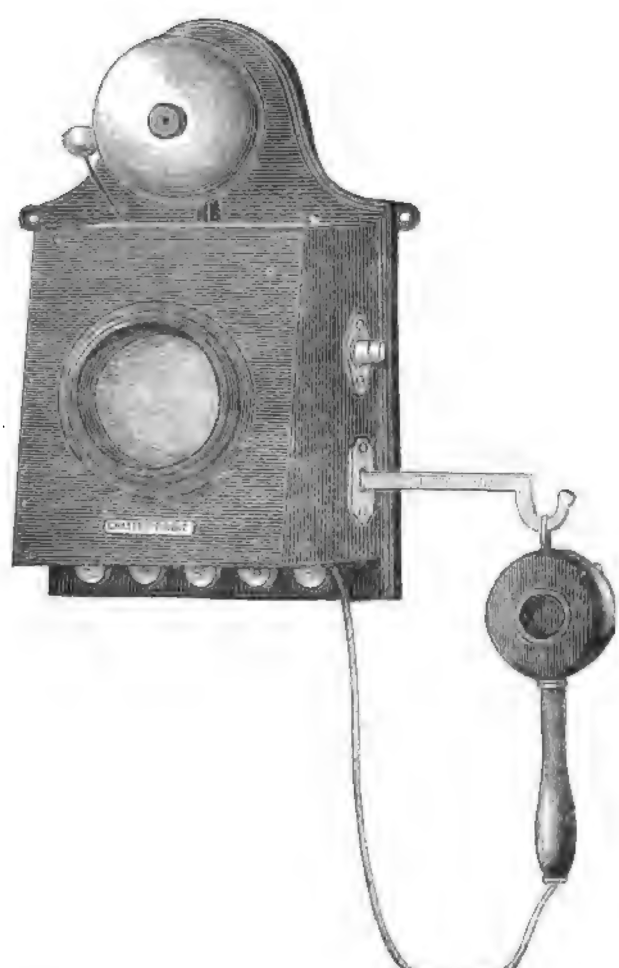


FIG. 1.

The receiver of this apparatus (the essential portion of which is shown in section by fig. 2) will be readily understood by those conversant with telephonic matters. The metal case in which the electro-magnetic coil is enclosed is of iron, and practically forms a prolongation of the lower pole of the electro-magnet. The edges of the ferrotype diaphragm rest on the edge of the metal box, and are secured by means of a screw cap. The magnetisation of the electro-magnet is effected by means of the line current, there being no induction-coil in the apparatus.

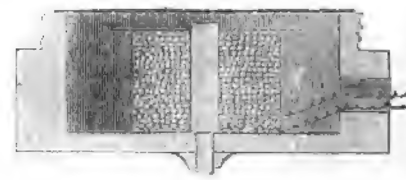


FIG. 2.

The microphonic transmitter, which is a feature in the apparatus, can be seen in fig. 3. It is formed of four vertical carbon pencils connected up in sets of two, the current passing down one set and up the other, as can be seen. The microphones are set on a thin board, which is hinged at the top, and which is kept pressed gently forward against its frame by means of a lead weight. The front surface of the board is opposite a round orifice (seen in fig. 1), into which the operator speaks. We may mention in conclusion that the four upright pieces of carbon-pencil belonging to the microphone transmitter are each wrapped round their middles with a band of sheet lead for the purpose of increasing their weight.

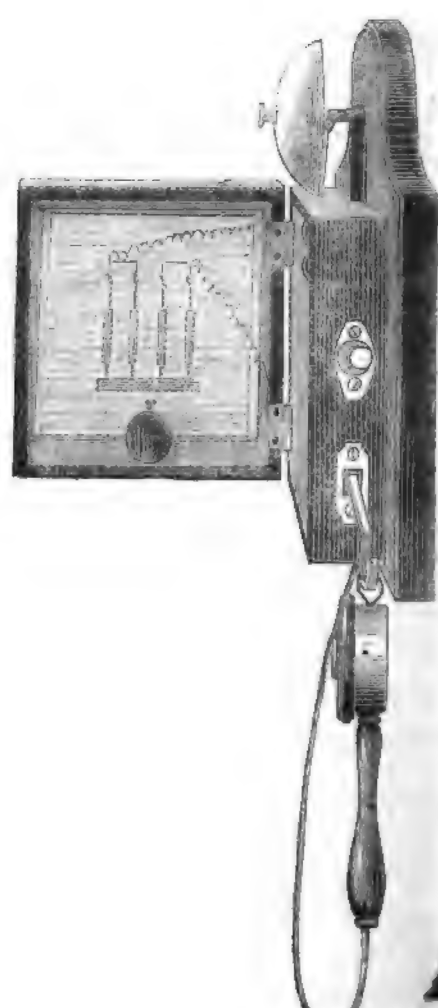


FIG. 3.

The apparatus is provided with the usual switch lever, alarum bell, and push button.

REPORT OF ELECTRICAL TESTS OF THE "1881" AND "1882" ATLANTIC CABLES OF THE AMERICAN TELEGRAPH AND CABLE COMPANY.

Taken at Penzance on the 1st and 2nd July, 1882.

SIEMENS BROTHERS & CO.'S TELEGRAPH WORKS,
MESSRS. SIEMENS BROS. & CO., Charlton Pier, Woolwich, Kent.
12, Queen Anne's Gate, Westminster. *July 27th*, 1882.

DEAR SIRS,—In accordance with your instructions, I proceeded to Penzance for the purpose of testing the "1881" and "1882" cables of the American Telegraph and Cable Company, to which end every facility was afforded me by the Company's Superintendent there, Mr. Mockridge. On the evening of the 1st instant, I tested the "1881" and "1882" cables separately, and on the 2nd instant, took a series of tests of both cables together, their ends being joined at Canso. I enclose a detailed description of the methods employed, the observations recorded, and the results deduced therefrom. I was fortunate in finding the cables remarkably free from disturbance by earth currents during the whole time I tested, and the results obtained are therefore the more accordant, and, as you will gather from inspection of the results, highly satisfactory, and evidencing both cables to be in perfect electrical condition.

I am, dear Sirs, yours faithfully,
FRANK JACOB, M.S.T.E., M.P.S. Lond., &c.

METHODS OF TESTING.

CONDUCTOR RESISTANCE.

This was determined by "reproduced deflection" as follows:—

The cable, with its distant end to earth, is connected through a suitably shunted galvanometer and battery with reversing key to earth, and a series of deflections (the battery being reversed between each reading) are taken as rapidly as possible and recorded; a resistance box is then substituted in place of the cable, and varied until the same deflections are reproduced; the resistances thus obtained are equal to the apparent resistances offered by the cable to either current. The harmonic mean of the results, with positive and negative current to line respectively, gives the true resistance of the conductor. The advantage gained by this over the usual "bridge" method is, that reversals can be taken far more rapidly, and the variation caused by earth currents, as well as being continuously under observation, be most easily eliminated; and if an "inferred zero" be used, by having the spot, when no current is passing through the galvanometer coils, considerably off the scale, the results can be determined to the same degree of accuracy as in the method referred to above.

ELECTRO-STATIC CAPACITY.

This was determined by the "Balance" method, as described by Sir W. Thomson in his Report of Testing the Direct United States Cable Company's cable, on the 16th and 17th December, 1875.

DIELECTRIC RESISTANCE.

This, as the earth currents were found to be remarkably steady, was measured in the ordinary way by the "deflection" method.

A battery of 40 Daniell's elements in series was used for all the tests.

Length of Cables from Sennen (Cornwall) to Dover Bay (Nova Scotia):

"1881" cable .. .. .. 2517·76 nautical miles.
"1882" cable .. .. .. 2562·70 ,, ,,

At the Cornwall end there is a quadruple underground cable laid to Penzance, the resistance of each core being 19·5 Siemens units, and electro-static capacity 3·1 microfarads. On the Nova-Scotian side four underground cables connect to Canso, having each a resistance of 15·5 Siemens units, and a capacity of 2·5 microfarads. The dielectric resistance of these may be neglected, in comparison with that of the submarine cables, without introducing any perceptible error.

Earth is obtained for each cable by one of the underground cables, which is connected at the landing place by well-soldered and massive joints to the sheathing wires of each shore-end cable respectively.

ELECTRICAL TESTS OF THE "1881" CABLE.

From 8.15 to 8.25 p.m., on July 1st, this cable was earthed and then insulated until 9.15 p.m. at Canso.

CONDUCTOR RESISTANCE.

Negative current to line 8,570 S.U. } harmonic mean =
Positive ,, ,, 7,650 S.U. } 8,084 Siemens units.

Subtracting 70 S.U. for the resistance of the underground cables at each side, we obtain 8,014 Siemens units as the resistance of the submarine cable, or a mean, per nautical mile, of 3·184 Siemens units.

ELECTRO-STATIC CAPACITY.

Negative current to line 904·9 mfds. } mean = 892·6
Positive ,, ,, 880·3 ,, } microfarads.

Subtracting 5·6 microfarads for that of the underground cables, we obtain 887 microfarads as the capacity for the submarine cable, or a mean of 0·352 microfarad per nautical mile.

DIELECTRIC RESISTANCE.

The "constant" of the galvanometer or the resistance which with infinite resistance in the shunt would give a deflection of one division, was 19,700 millions Siemens units, and the deflections through the cable were taken with a shunt having one-ninth of the galvanometer's resistance.

The results are exhibited in tabular form.

Column I. gives the time of electrification;
,, II. ,, the mean deflection observed each minute;
,, III. ,, the resistance calculated from "II.";
,, IV. ,, these resistances reduced for electrification to the value for the first minute's electrification, so as to obtain the mean first minute result from the ten minutes' test.

POSITIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	320	6·16	6·2	
2	230	8·56	7·1	
3	300	6·57	5·1	
4	230	8·56	6·3	Mean of results reduced to electrification after first minute = 8·3 millions Siemens units, or 20,900 millions Siemens units per nautical mile.
5	100	19·70	[14·2]*	
6	180	10·95	7·6	
7	150	13·14	8·9	
8	120	16·42	10·9	
9	120	16·42	10·6	
10	100	19·70	11·9	

NEGATIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	410	4·80	4·8	
2	330	5·97	4·9	
3	200	9·85	7·6	
4	100	19·70	14·6	Mean of results reduced to electrification after first minute = 7·4 millions Siemens units, or 18,640 millions Siemens units per nautical mile.
5	50	39·40	[28·3]*	
6	180	10·95	7·6	
7	180	10·95	7·4	
8	200	9·85	6·5	
9	200	9·85	6·3	
10	170	11·59	7·3	

The cable was earthed for ten minutes between the tests with the two currents.

Mean of results with both currents to line, reduced to electrification after first minute:

7·85 millions Siemens units for the whole cable, or 19,770 millions Siemens units per nautical mile.

ELECTRICAL TESTS OF THE "1882" CABLE.

Earthed at Canso 9.15 to 9.25 p.m., and insulated till 10.15 p.m.

CONDUCTOR RESISTANCE.

Negative current to line 8,334 S.U. } Mean:
Positive ,, ,, 8,334 ,, } 8,334 Siemens units.

No difference between the results with each current, thus evidencing the smallness of the earth currents. Subtracting 70 Siemens units for the resistance of the underground cables, this gives 8,264 Siemens units for the resistance of the submarine cable, or a mean, per nautical mile, of 3·225 Siemens units.

ELECTRO-STATIC CAPACITY.

The same with both currents to line, viz., 930·6 microfarads. Subtracting 5·6 microfarads for the underground cables, the submarine cable has a capacity of 925 microfarads, or a mean of 0·361 microfarad per nautical mile.

DIELECTRIC RESISTANCE.—POSITIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	320	6·16	6·2	
2	270	7·30	6·1	
3	260	7·58	5·9	
4	250	7·88	5·8	Mean of results reduced to electrification after first minute = 7·0 millions Siemens units, or 17,940 millions Siemens units per nautical mile.
5	220	8·95	6·4	
6	210	9·39	6·5	
7	170	11·59	7·8	
8	160	12·31	8·1	
9	160	12·31	7·9	
10	140	14·07	8·9	

* The figures in brackets are excluded, being due to a variation in earth currents.

NEGATIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	320	6·16	6·1	
2	170	11·59	9·6	
3	170	11·59	9·0	
4	220	8·95	6·6	Mean of results reduced to electrification after first minute = 7·8 millions Siemens units, or 20,000 millions Siemens units per nautical mile.
5	170	11·59	8·3	
6	150	13·14	9·1	
7	180	10·95	7·4	
8	100	19·70	[13·0]*	
9	220	8·95	5·8	
10	150	13·14	8·3	

The cable was earthed for ten minutes between each series.

Mean of results with both currents to line, reduced to electrification after first minute,

= 7·4 Siemens units for the whole cable, or 18,970 millions Siemens units per nautical mile.

ELECTRICAL TESTS OF THE "1881" AND "1882" CABLES JOINED.

July 2nd, 8.15 a.m., both cables were joined at Canso.

CONDUCTOR RESISTANCE.

Measured by the "bridge" method.

$\left.\begin{array}{l} -\ 16{,}409 \text{ Siemens units} \\ +\ 16{,}284 \text{ Siemens units} \end{array}\right\}$ mean = 16346·5 Siemens units.

Subtracting 70 Siemens units for the resistance of the underground cables at each end, gives:

16276·5 Siemens units for the sum of the resistance of the two cables, which agrees very closely with the sum of the resistances of the two cables taken separately the day before, viz., 16,278 Siemens units.

DIELECTRIC RESISTANCE.

The deflections were taken with a shunt having a resistance 1-99th of that of the galvanometer, and the "constant" was 19,600 millions Siemens units.

For these two series the ends of both cables were connected at Penzance, and thus the circuit was charged simultaneously from both ends.

NEGATIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	70	2·80	2·80	
2	58	3·38	2·82	
3	32	6·12	4·74	
4	55	3·56	2·64	Mean reduced to electrification after first minute = 3·945 millions Siemens units, or 20,040 millions Siemens units per nautical mile.
5	20	9·80	7·05	
6	60	3·26	2·27	
7	25	7·84	5·30	
8	35	5·60	3·71	
9	40	4·90	3·16	
10	25	7·84	4·96	

Cable earthed for ten minutes, then

POSITIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	90	2·18	2·18	
2	60	3·26	2·72	
3	47	4·17	3·23	
4	35	5·60	4·15	Mean reduced to electrification after first minute = 3·961 millions Siemens units, or 20,120 millions Siemens units per nautical mile.
5	35	5·60	4·03	
6	20	9·80	6·80	
7	40	4·90	3·31	
8	20	9·80	6·49	
9	40	4·90	3·16	
10	35	5·60	3·54	

The cable was again earthed for fifteen minutes, and then the following series taken by charging the end of the "1881" cable and leaving the end of the "1882" cable insulated free in air at Penzance. It will be noticed that the first three minutes' readings give higher deflections than in the former series; this is due to the length of cable now existing between the charging battery and the distant end, which is insulated, thus increasing the time required for the cable to arrive at a uniform tension throughout.

* The figures in brackets are excluded, being due to a variation in earth currents.

NEGATIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	190	1·03	1·03	
2	75	2·61	2·18	
3	50	3·92	3·04	
4	45	4·36	3·23	Mean of results reduced to electrification after first minute = 4·25 millions Siemens units, or 21,600 millions Siemens units per nautical mile.
5	30	6·53	4·70	
6	20	9·80	6·80	
7	20	9·80	6·62	
8	20	9·80	6·49	
9	30	6·53	4·21	
10	15	13·06	[8·26]*	

The cable was then earthed for ten minutes, and the following series taken, with the end of the "1882" cable charged, and the end of the "1881" cable insulated free in air at Penzance.

POSITIVE CURRENT TO LINE.

I. Minutes.	II. Deflection.	III. Millions Siemens units.	IV. Millions Siemens units.	
1	200	0·98	0·98	
2	75	2·61	2·18	
3	60	3·27	2·53	
4	30	6·53	4·84	Mean of results reduced to electrification after first minute = 3·95 millions Siemens units, or 20,070 millions Siemens units per nautical mile.
5	30	6·53	4·70	
6	10	19·60	[13·61]*	
7	30	6·53	4·41	
8	25	7·84	5·19	
9	30	6·53	4·21	
10	20	9·80	6·20	

The mean of the four series of tests of the two cables joined at Canso gives a result for the first minute's electrification of 4·026 millions Siemens units, or 20,450 millions Siemens units per nautical mile.

Appended is a summary of the tests of the two cables since completion of laying up to date, as well as of the results obtained from the sum of the tests of the separate coils composing each cable, which were taken at the works during the manufacture of the cable at the two fixed temperatures of 75° and 50° Fahrenheit.

SUMMARY OF RESULTS OF ELECTRICAL TESTS OF THE "1881" AND "1882" ATLANTIC CABLES.

	"1881" CABLE. Length = 2517·76 nautical miles.			"1882" CABLE. Length = 2562·7 nautical miles.		
	Mean of the tests taken from both terminal points during the time from 9th July, 1881 (completion of cable), to 25th July, 1882.	Calculated from the sum of the tests of the separate coils composing the cable, taken during manufacture.		Mean of the tests taken from both terminal points during the time from April 3rd, 1882 (completion of cable), to 25th July, 1882.	Calculated from the sum of the tests of the separate coils composing the cable, taken during manufacture.	
		At 75° F.	At 50° F.		At 75° F.	At 50° F.
Conductor resistance in Siemens units... ... Total	8036	8727	8281	8267	8993	8533
Conductor resistance mean per nautical mile	3·192	3·4[illegible]6	3·289	3·226	3·509	3·330
Electro-static capacity in microfarads ... Total	918	936·3	935·1	929·3	937·2	936·0
Electro-static capacity mean per nautical mile	0·3646	0·3720	0·3714	0·3626	0·3657	0·3651
Dielectric resistance in millions Siemens units after one minute's electrification ... ... Total	7·1	0·2025	1·600	6·5	0·1982	1·566
Dielectric resistance mean per nautical mile	17880	510	4030	16660	508	4014
$\Sigma \frac{1}{p \times t}$ = Co-efficient for reduction of total resistance to that per nautical mile at 75° F. and pressure of one atmosphere	92·9	2517·7	318·7	81·55	2562·7	324·3
Dielectric resistance thus reduced, in millions Siemens units	660	510	510	530	508	503

FRANK JACOB, *Chief Electrician.*

* The figures in brackets are excluded, being due to a variation in earth currents.

THE BRITISH ASSOCIATION.

[*Specially reported for the* ELECTRICAL REVIEW.]

ADDRESS TO THE MATHEMATICAL AND PHYSICAL SCIENCE SECTION.

By LORD RAYLEIGH, M.A., F.R.S., F.R.A.S.

IN common with some of my predecessors in this chair, I recognise that probably the most useful form which a presidential address could take would be a summary of the progress of physics, or of some important branch of physics, during recent years. But the difficulties of such a task are considerable, and I do not feel myself equal to grappling with them. The few remarks which I have to offer are of a general—I fear it may be thought of a commonplace—character. All I can hope is that they may have the effect of leading us into a frame of mind suitable for the work that lies before us.

The diversity of the subjects which come under our notice in this section, as well as of the methods by which alone they can be adequately dealt with, although a sign of the importance of our work is a source of considerable difficulty in the conduct of it. From the almost inevitable specialisation of modern science, it has come about that much that is familiar to one member of our section is unintelligible to another, and that details whose importance is obvious to the one fail altogether to rouse any interest in the mind of the other. I must appeal to the authors of papers to bear this difficulty in mind, and to confine within moderate limits their discussion of points of less general interest.

Even within the limits of those departments whose foundation is evidently experimental, there is room, and indeed necessity, for great variety of treatment. One class of investigators relies mainly upon reiterated appeals to experiment to resolve the questions which appear still to be open, while another prefers, with Thomas Young, to base its decisions as far as possible upon deductions from experiments already made by others. It is scarcely necessary to say that in the present state of science both methods are indispensable. Even where we may fairly suppose that the fundamental principles are well established, careful and often troublesome work is necessary to determine with accuracy the constants which enter into the expression of natural laws. In many cases the accuracy desirable, even from a practical point of view, is hard to attain. In many others, where the interest is mainly theoretical, we cannot afford to neglect the confirmations which our views may derive from the comparison of measurements made in different fields, and in face of different experimental difficulties. Examples of the inter-dependence of measurements apparently distinct will occur to every physicist. I may mention the absolute determinations of electrical resistance, and of the amounts of heat developed from electrical and mechanical work, any two of which involve also the third, and the relation of the velocity of sound to the mechanical and thermal properties of air.

Where a measurement is isolated, and not likely to lead to the solution of any open question, it is doubtless possible to spend upon it time and attention that might with advantage be otherwise bestowed. In such a case we may properly be satisfied for a time with work of a less severe and accurate character, knowing that with the progress of knowledge the way is sure to be smoothed both by a better appreciation of the difficulties involved and by the invention of improved experimental appliances. I hope I shall not be misunderstood as underrating the importance of great accuracy in its proper place if I express the opinion that the desire for it has sometimes had a prejudicial effect. In cases where a rough result would have sufficed for all immediate purposes, no measurement at all has been attempted, because the circumstances rendered it unlikely that a high standard of precision could be attained. Whether our aim be more or less ambitious, it is important to recognise the limitations to which our methods are necessarily subject, and as far as possible to estimate the extent to which our results are uncertain. The comparison of estimates of uncertainty made before and after the execution of a set of measurements may sometimes be humiliating, but it is always instructive.

Even when our results show no greater discrepancies than we were originally prepared for, it is well to err on the side of modesty in estimating their trustworthiness. The history of science teaches only too plainly the lesson that no single method is absolutely to be relied upon, that sources of error lurk where they are least expected, and that they may escape the notice of the most experienced and conscientious worker. It is only by the concurrence of evidence of various kinds and from various sources that practical certainty may at last be attained, and complete confidence justified. Perhaps I may be allowed to illustrate my meaning by reference to a subject which has engaged a good deal of my attention for the last two years—the absolute measurement of electrical resistance. The unit commonly employed in this country is founded upon experiments made about twenty years ago by a distinguished committee of this association, and was intended to represent an absolute resistance of 10^9 C.G.S.—*i.e.*, one ohm. The method employed by the committee at the recommendation of Sir W. Thomson (it had been originally proposed by Weber) consisted in observing the deflection from the magnetic meridian of a needle suspended at the centre of a coil of insulated wire, which formed a closed circuit, and was made to revolve with uniform and known speed about a vertical axis. From the speed and deflection in combination with the mean radius of the coil and the number of its turns, the absolute resistance of the coil, and thence of any other standard, can be determined.

About ten years later Kohlrausch attacked the problem by another method, which it would take too long to explain, and arrived at the result that the B.A. unit was equal to 1·02 ohms—about 2 per cent. too large. Rowland, in America, by a comparison between the steady battery current flowing in a primary coil with the transient current developed in a secondary coil when the primary current is reversed, found that the B.A. unit was ·991 ohms. Lorentz, using a different method again, found ·980, while H. Weber, from distinct experiments, arrived at the conclusion that the B.A. unit was correct. It will be seen that the results obtained by these highly competent observers range over about 4 per cent. Two new determinations have lately been made in the Cavendish laboratory at Cambridge, one by myself with the method of the revolving coil, and another by Mr. Glazebrook, who used a modification of the method followed by Rowland, with the result that the B.A. unit is ·986 ohms. I am now engaged upon a third determination, using a method which is a modification of that of Lorentz.

In another important part of the field of experimental science, where the subject-matter is ill understood, and the work is qualitative rather than quantitative, success depends more directly upon sagacity and genius. It must be admitted that much labour spent in this kind of work is ill-directed. Bulky records of crude and uninterpreted observations are not science, nor even in many cases the raw material out of which science will be constructed. The door of experiment stands always open; and when the question is ripe, and the man is found, he will nine times out of ten find it necessary to go through the work again. Observations made by the way, and under unfavourable conditions, may often give rise to valuable suggestions, but these must be tested by experiment, in which the conditions are simplified to the utmost, before they can lay claim to acceptance.

When an unexpected effect is observed, the question will arise whether or not an explanation can be found upon admitted principles. Sometimes the answer can be quickly given; but more often it will happen that an assertion of what *ought* to have been expected can only be made as the result of an elaborate discussion of the circumstances of the case, and this discussion must generally be mathematical in its spirit, if not in its form. In repeating, at the beginning of the century, the well-known experiment of the inaudibility of a bell rung in vacuo, Leslie made the interesting observation that the presence of hydrogen was inimical to the production of sound, so that not merely was the sound less in hydrogen than in air of equal pressure, but that the actual addition of hydrogen to rarefied air caused a diminution in the intensity of sound. How is this remarkable fact to be explained? Does it prove that, as Herschel was inclined to think, a mixture of gases of widely different densities differs in its acoustical properties from a single gas? These questions could scarcely be answered satisfactorily but by a mathematical investigation of the process by which vibrations are communicated from a vibrating solid body to the surrounding gas. Such an investigation, founded exclusively upon principles well established before the date of Leslie's observation, was undertaken years afterwards by Stokes, who proved that what Leslie observed was exactly what ought to have been expected. The addition of hydrogen to attenuated air increases the wave-length of vibrations of given pitch, and consequently the facility with which the gas can pass round the edge of the bell from the advancing to the retreating face, and thus escape those rarefactions and condensations which are essential to the formation of a complete sound wave. There remains no reason for supposing that the phenomenon depends upon any other elements than the density and pressure of the gaseous atmosphere, and a direct trial, *e.g.*, a comparison between air and a mixture of carbonic anhydride and hydrogen of like density, is almost superfluous.

Examples such as this, which might be multiplied *ad libitum*, show how difficult it often is for an experimenter rightly to interpret his results without the aid of mathematics. It is eminently desirable that the experimenter himself should be in a position to make the calculations, to which his work gives occasion, and from which in return he would often receive valuable hints for further experiment. I should like to see a course of mathematical instruction arranged with especial reference to physics, within which those whose bent was plainly towards experiment might, more or less completely, confine themselves. Probably a year spent judiciously on such a course would do more to qualify the student for actual work than two or three years of the usual mathematical curriculum. On the other side it must be remembered that the human mind is limited, and that few can carry the weight of a complete mathematical armament without some repression of their energies in other directions. With many of us difficulty of remembering, if not want of time for acquiring, would impose an early limit. Here, as elsewhere, the natural advantages of a division of labour will assert themselves. Innate dexterity and facility in contrivance, backed by unflinching perseverance, may often conduct to successful discovery or invention a man who has little taste for speculation; and on the other hand the mathematician, endowed with genius and insight, may find a sufficient field for his energies in interpreting and systematising the work of others.

The different habits of mind of the two schools of physicists sometimes lead them to the adoption of antagonistic views on doubtful and difficult questions. The tendency of the purely experimental school is to rely almost exclusively upon direct evidence, even when it is obviously imperfect, and to disregard arguments which they stigmatise as theoretical. The tendency of the mathematician is to overrate the solidity of his theoretical structures, and to forget the narrowness of the experimental foundation upon which many of them rest.

By direct observation, one of the most experienced and successful experimenters of the last generation convinced himself that light of definite refrangibility was capable of further analysis by absorption. It has happened to myself, in the course of measurements of the absorbing power of various media for the different rays of the spectrum, to come across appearances at first sight strongly confirmatory of Brewster's views, and I can therefore understand the persistency with which he retained his opinion. But the possibility of further analysis of light of definite refrangibility (except by polarisation) is almost irreconcilable with the wave theory, which on the strongest grounds had been already accepted by most of Brewster's

contemporaries; and in consequence his results, though urgently pressed, failed to convince the scientific world. Further experiment has fully justified this scepticism, and in the hands of Airy, Helmholtz, and others, has shown that the phenomena by which Brewster was misled can be explained by the unrecognised intrusion of diffused light. The anomalies disappear when sufficient precaution is taken that the refrangibility of the light observed shall really be definite.

On similar grounds undulationists early arrived at the conviction that physically light and invisible radiant heat are both vibrations of the same kind, differing merely in wave-length; but this view appears to have been accepted slowly, and almost reluctantly, by the experimental school.

When the facts which appear to conflict with theory are well-defined and lend themselves easily to experiment and repetition, there ought to be no great delay in arriving at a judgment. Either the theory is upset, or the observations, if not altogether faulty, are found susceptible of another interpretation. The difficulty is greatest when the necessary conditions are uncertain, and their fulfilment rare and uncontrollable. In many such cases an attitude of reserve, in expectation of further evidence, is the only wise one. Premature judgments err perhaps as much on one side as on the other. Certainly in the past many extraordinary observations have met with an excessive incredulity. I may instance the fire-balls which sometimes occur during violent thunderstorms. When the telephone was first invented, the early reports of its performances were discredited by many on quite insufficient grounds.

It would be interesting, but too difficult and delicate a task, to enumerate and examine the various important questions which remain still undecided from the opposition of direct and indirect evidence. Merely as illustrations I will mention one or two in which I happen to have been interested. It has been sought to remedy the inconvenience caused by excessive reverberation of sound in cathedrals and other large unfurnished buildings by stretching wires overhead from one wall to another. In some cases no difference has been perceived, but in others it is thought that advantage has been gained. From a theoretical point of view it is difficult to believe that the wires could be of service. It is known that the vibrations of a wire do not communicate themselves in any appreciable degree directly to the air, but require the intervention of a sounding-board, from which we may infer that vibrations in the air would not readily communicate themselves to stretched wires. It seems more likely that the advantage supposed to have been gained in a few cases is imaginary than that the wires should really have played the part attributed to them.

The other subject on which, though with diffidence, I should like to make a remark or two, is that of Prout's law, according to which the atomic weights of the elements, or at any rate of many of them, stand in simple relation to that of hydrogen. Some chemists have reprobated strongly the importation of *à priori* views into the consideration of the question, and maintain that the only numbers worthy of recognition are the immediate results of experiment. Others, more impressed by the argument that the close approximations to simple numbers cannot be merely fortuitous, and more alive to the inevitable imperfections of our measurements, consider that the experimental evidence against the simple numbers is of a very slender character, balanced, if not outweighed, by the *à priori* argument in favour of simplicity. The subject is eminently one for further experiment; and as it is now engaging the attention of chemists, we may look forward to the settlement of the question by the present generation. The time has perhaps come when a redetermination of the densities of the principal gases may be desirable—an undertaking for which I have made some preparations.

If there is any truth in the views that I have been endeavouring to impress, our meetings in this section are amply justified. If the progress of science demands the comparison of evidence drawn from different sources, and fully appreciated only by minds of different order, what may we not gain from the opportunities here given for public discussion, and, perhaps more valuable still, private interchange of opinion? Let us endeavour, one and all, to turn them to the best account.

THE EDISON SYSTEM OF ELECTRIC DISTRIBUTION.

[Paper by F. J. Sprague, read at meeting of Section A of British Association, Friday, August 25th, 1882.]

I wish to speak of Mr. Edison's system as it has appeared to me after a thorough investigation and study of the same, extending over several months and with great facilities at my command, and my conclusions are based not on Mr. Edison's claims, or those of his friends, but as the result of a candid investigation. Mr. Edison's ambition has been far reaching, and he designs to establish a system of distribution, not alone for lighting, but for almost every purpose to which the electric current can be put: and he recognises the all-important principle that all parts of such a system are mutually dependent; that thorough mathematical and engineering talent must be used; that no detail is so unimportant, no real objection so trivial, but that it requires patient consideration; that dynamos, meters, lamps, motors, conductors, districts laid out, capital invested, and energy wasted, must all be calculated with reference to each other; in short, that economy and reliability are the great ends to be attained. The result is that he comes now before the world, after three years of hard work and patient experimenting, feeling fully equipped and able to establish thoroughly reliable and extensive installations. I have stated some of the requirements of a system of general distribution, and will consider that of Mr. Edison in detail and as a whole. I shall not give a full description of all the parts, but intend rather to consider it from a practical and economic point of view.

Dynamos.

These generators, which have armatures wound or connected on a modification of the Hefner-Alteneck system, may be divided into three classes.

1. Those having wire-wound armatures, the coils being wound on a wooden cylinder wrapped with a soft iron wire. These armatures are driven by belting, and rotate between the faces of long vertical magnets at a speed of 800 to 1,200 revolutions per minute, according to the size of machine and the number of lamps. By using a large mass of metal a powerful magnet may be created, rendering necessary a less number of convolutions of wire, and consequently less heat and waste in the armature for a given electromotive force. By using long magnets the mean resultant of the convolutions of wire is brought much nearer the centre of the core than would be the case with the same weight of metal and a shorter length. On account of this a more active magnetic field is produced, one with a greater projective power, and less current may be used in the field coils. This can be exemplified in a striking manner by reforging the cores with the same amount of iron, but making them shorter and rewinding with the same amount of wire as now used. With the same speed of armature and the same number of convolutions the electromotive force of the machine will fall very appreciably; and this lower electromotive force can be obtained by using the large magnets with the faces at a much greater distance from the surface of the armature. The commutator is long; its life or time of running without repair is thus increased, and should a movable commutator be fitted, the trouble of taking care of a machine would be reduced to a minimum. There are four varieties, or classes, with capacities of 70, 150, 250, and 500 lamps, and the number of magnets depends on the size of the machine. Each pair of cores are in series. If two or more pairs are used, the pairs are thrown in parallel circuit.

The resistance of the field coils may be roughly expressed by $\frac{3{,}000}{L}$ where L is the maximum number of lamps. In the 70 lighter this resistance is 40·4 ohms cold, and 41·5 warm, and the field is in parallel circuit with the external circuit. The machine generates an electromotive force of about 110 volts and runs very quietly. Ordinarily 60 lamps would be the proper load if running for a long time, but 85 can be readily carried for a shorter period. The ordinary limit to the power of a machine is the heating of the armature, which depends upon the total volume of current flowing. The armature has a resistance of ·16 ohms cold and ·20 warm. With a difference of potential of 100 volts at the terminals, the field coils would require 10,650 foot-pounds of electrical energy expended per minute, or ·32 horse-power, *i.e.*, about a pound of coal per hour. The energy lost in the armature would be $c^2 \times 8{\cdot}848$, c being total current in ampères. With a circuit of seventy 140-ohm lamps, the external resistance, including the field coils, but not the conductors which are very low, would be two ohms, over 9·5 times the internal. My experience with the larger machines of this type does not warrant me in commenting on their performance, but from the knowledge of their construction, I should judge their efficiency to be about the same. 9 or 10 horse-power should be delivered to the pulley of the 70-light machine.

2. The second class comprises machines with magnets as in the first, which may be coupled in series, or in parallel circuit making their resistance about ¼, and enabling a given electromotive force to be obtained with a lower speed. The armature is built up of iron discs, and has a sheathing of copper bars, connected across the ends by copper discs. It is of very low resistance, in the ordinary size 1-10th of that of the 70-lighter. It is run at the same speed, develops a lower locomotive force, and is suitable for lamps of lower resistance. The following table is from a careful test of this machine by Mr. J. A. Howell, at Stephen's Institute. These tests were made—the first, by means of the voltameter; the second, by calorimeter; and the third, by the electromotive force and resistance method. By "efficiency" is meant the ratio of the total electrical energy developed to the power required to turn the armature in the magnetic field. By "commercial efficiency" is meant the ratio of energy appearing in the external circuit to the power required to drive the machine, including friction.

DATA.	1st Experiment.	2nd Experiment.	3rd Experiment.
Time of duration	·15	·16	—
Speed of dynamometer	400·5	394·	355·
Resistance of armature	·016	·016	·016
Total resistance of circuit	·773	·696	·658
E.M.F.	64·74	55·10	53·00
C.	83·75	79·17	80·55
Efficiency	·955	·967	·935
Commercial efficiency	·861	·901	·87
Foot-pounds of electrical energy in—			
1. Armature	4965·	5604·	5026·
2. Field coils	4647·	4216·	3347·
3. External circuit...	230268·	233940·	198301·
Percentage of same appearing in—			
1. Armature	2·07	2·30	2·43
2. Field coils	1·94	1·73	[illegible]
3. Both	4·01	4·03	4·0[illegible]
4. External circuit...	95·99	95·97	95·95

These armatures are somewhat difficult of construction, bu[t it] seems to me their efficiency is so remarkable that the extra ex[pense] is warrantable, and I should like to see all the machines const[ructed] on this rather than on the wire principle.

3. This class comprises machines with armatures on the same plan as the last, but are much larger, of lower resistance and of double the electromotive force. The field magnets are horizontal, have twelve cores, and their resistance is about 1-7th that of the 70 lighter. The armature is connected directly to the engine, which is a well proportioned, high speed, non-condensing engine, known as the Porter-Allen; only three of these dynamos are in Europe, one being in Paris and two at the central station at Holborn Viaduct. The normal capacity of No. 3 is 1,000 lights, but it can be readily run up to 1,200 or 1,300, and by coupling the field magnets so that their resistance is about 4-9ths of the Holborn machine, Mr. Edison recently ran 1,630 lamps at twenty candle-power, and I have been informed that No. 3, before leaving New York, was tested with 1,320 lamps for fifteen consecutive hours, I suppose at sixteen candles. From Howell's experiments, one lamp of 140·5 ohms resistance required for an illumination of sixteen candles a potential of 99 volts, and used 3,107·41 foot-pounds of energy per minute. The potential and resistance give a current of 0·7046 ampères, which is about the average of five lamps. 1,320 lamps would then require 930·072 ampères, and the external resistance would be ·1064 ohms, or twenty-eight times the internal. Call the resistance of leading wires ·01 ohm, a tenth of the lamp resistance, which will give a lamp circuit resistance of ·1164 ohm. The resistance of the field magnets is 6·73 cold. Allow 5 per cent. increase in these coils, and 10 per cent in the armature for heating, and consider the conductor resistance as between the lamps and machines. Thence we have a difference of potential at the brushes, and terminals of the field coils, of 108·05 volts and a field current of 15·29 ampères, giving a total current in the armature of 945·36 ampères, and an electromotive force of 111·67 volts. This gives an equivalent of 73,090 foot-pounds in the field coils, 387,200 in the leading wires, 163,690 in the armature, and 4,064,050 in the lamps, making a total of 4,688,030 foot-pounds of electrical energy per minute. In the absence of exact data, suppose the efficiency of this machine to be 93 per cent., two less than that of the small machine before considered; then we would have 5,040,860 foot-pounds per minute applied to the axis of the armature, or 152·75 horse-power, of which there was expended in the lamp circuit 123·15, in the external conductors 11·73, in the field circuit 2·22, in the armature 4·96, and wasted 10·69—*i.e.*, 80·6, 7·6, 1·5, 3·3, and 7·0 per cent. respectively. Although 4·96 horse-power may seem a large loss in the armature, it is a very small percentage on the whole; yet a diminution of ·0001 ohms would diminish the loss by 3,916 lbs. per minute. We thus see how absolutely necessary it is to have the lowest possible resistance in the armature when dealing with large currents, the energy of which, expended within a circuit of given resistance, increases with the square of the current. Were this same current, 945·36 ampères, to flow through an armature of a tenth of an ohm resistance, there would be a loss of over 118 horse-power, and were the resistance one ohm, nearly 20,000 foot-tons would be converted into heat per minute. In fact, it would be practically an impossibility to build an armature of this resistance to stand the current. Another instructive calculation may be made by reducing a armature to a nominal equivalent foot conductor. In this it is not necessary that we may compare with another machine to consider the relative intensities of the field. All machines have certain parts of the conductors which are inactive, and the less this proportion the better for the machine and higher its efficiency. In this generator there are 98 bars on the armature, the average length being four feet nine inches. The circle of revolution is 27·5 inches in diameter. At each end are 49 circular plates, each of these being the equivalent of a conductor 27·5 inches long. The speed of the engine is about 320 revolutions. From these data I find the useful part of the armature equivalent to a conductor one foot long, moving with a velocity of 15,682 feet per second, and the inactive part equal to a foot conductor with a second velocity of 6,507 feet, or the whole equivalent to a foot conductor with velocity of 22,189 feet per second. With an electromotive force of 111·67 volts this gives a foot conductor a second velocity of 198·7 feet per volt developed, and with 5,040,860 foot-pounds per minute, an absorption of 3·78 foot-pounds in a foot conductor per foot per second, of which 93 per cent. is developed into electrical energy. This is an admirable showing, and affords some data on which to build a still larger machine. I am inclined to think that were the armature built of rings instead of discs, even less power would be wasted. The limit to the size of machines to be built is reached when we determine how much waste can be afforded, and how much must of necessity be lost in the armature. The current generated is taken off by four pairs of independent brushes, the surface of the commutators being slightly amalgamated. The sectional area of the brushes on one side is about 4 square inches. The commutator blocks should be movable, and I understand all large machines now are so constructed. I have seen the largest machine here run one lamp of about 16 candles, and at other times 800 to 1,000 at from 20 to 25 candles, or even higher.

The potential is such that the commutator brushes can be readily grasped. The armature heats moderately—the radiation being hindered by a thorough insulation—but a blower forces air around it to prevent undue rise of temperature. The engine seems to me an excellent one, and now that certain opposition to large dynamos has been hushed, the engine becomes the moot point. The general experience has been that high speed engines on variable work and long runs have given a great deal of trouble with lost action, back lash, loosening nuts, and wear of piston, cylinder, valves, and guide-bars. In a large system of distribution the variation of load is much more gradual than in a tool shop or factory, and consequently the work is better adapted for a high speed engine than many other kinds might be. For large engines there may be urged less wear and tear, fewer individual parts to look after, less liability to a break down, a greater number of good engines to choose from, and higher economy. In favour of the higher speed engine, there is less boiler space required, the individuality of each engine, the less inertia, and in case of break down the disabling of a much smaller part of the plant. I confess to have had a prejudice against high speed engines, but this has mostly disappeared, and an inspection of one of the engines at Holborn Viaduct shows it to be in thoroughly good condition. The boilers are the Babcock & Wilcox patent, adapted to quick steam and high pressure. They need to be well taken care of, but are widely and favourably enough known to engineers to need no comment.

LAMPS.

On account of the need of having the external resistance high compared with the internal, and this ratio necessarily increases with the volume and current required; the resistance entering into a part of the lamps and not into others; the necessity for allowing a smaller illumination for different lamps; and from the fact that a given illuminating power can be obtained from a fine filament with a less loss of energy in conductors than from a coarse one, Mr. Edison has aimed at carbons of a very high resistance. There have been difficulties in the way by no means easy to surmount. One is that carbon diminishes its resistance when hot, another that strength, elasticity, and life are wanted. A third is that lamps of like illuminating power should have the same resistance and certain to last a reasonable time. Remarkable advance has been made, and 16-candle lamps are now made of 240 ohms resistance cold, and 140 hot, and 8-candle lamps of about 475 ohms cold and 275 hot, exceedingly strong and elastic, and of long average life. This life is still quite variable and it cannot be foretold, about 1,100 hours being their average at present. Made of the finest bamboo, they are fibrous, of very even texture and very fine. The carbons are joined to copper terminals of the platinum wires in the glass, the copper clamps and ends of the carbons being plated in a solution. The platinum wires are sealed in a hot press joint at the inner end of a tube sealed in the neck of the globe, whence copper wires lead to brass connections, which are brought into contact with similar connections in the socket. The carbons are so elastic that they will vibrate from one side of the globe to the other. When hot they are less elastic. For lamps of higher illuminating power the width of the carbon is increased while the thickness remains about the same. The use of two or more carbons is not a practical arrangement. This gives about double the illuminating surface, half the resistance, and requires double the energy. There is room for great improvement in the matter of lamps of high power, for I have no doubt that in the near future incandescent lamps of 200 or 300 candle-power and higher will be perfectly practicable. It has been said that lamps should have the highest possible resistance. This is not so. The carbons have been reduced about as far as possible in width. They may be made thinner, and thus a step made to lighter weight, higher resistance, and greater economy. But the real limit is the potential which can be used. The resistance of a carbon of given illuminating power must depend on the foot-pounds of energy expended and the potential at the terminals. The following table will show the resistances for several degrees of potentials and economy:—

Foot-pounds of Electric Energy used in Lamp per minute.	Number of Lamps per H.-P.	Candles per H.-P.	Resistance of Lamps in ohms when the Electromotive Force is in volts. 100	125	150	175	200
3,000	11	176	147	246	332	452	590
2,500	13·2	211·2	177	293	398	542	708
2,000	16·5	264	221	367	498	677	885
1,500	22·	352	295	489	664	903	1180

Already there has been produced about twelve lamps per horse-power, but I think that 2,000 foot-pounds of energy is as low as can be hoped for, and I do not feel that we should go above 150 volts potential at the lamp terminals. If this end can be obtained, the carbons must have a resistance of 498 ohms hot, and there will be produced over 260 candles per horse-power of electrical energy. I am confining these computations and statements to the case of lamps not giving over 16 candles, a standard of which the long use of gas has led to the adoption. The difference in work between a 140-ohm lamp at 15 and 16 candles power is about 84 foot-pounds, which will allow two ohms difference of line resistance for two lamps, *i.e.*, about 1,000 feet of No. 15 wire, or one mile of No. 8. Neither a high resistance nor a high potential is necessary to get a certain candle-power with a certain expenditure of energy in a lamp of given mass, but a greater current is necessary with the lamp of low resistance. This means a greater loss in the conductors, a loss efficiency of generators, and a much more limited distribution. Let me illustrate by a particular instance. A current of 400 or 500 ampères flowing through a conductor an inch in diameter, exposed to the air, would heat it very appreciably, say, 15° C. above the atmosphere. Now, what are the conditions in a system of distribution? The cable must be thoroughly insulated, and hence there will not be a free radiation of heat, although surrounded by moist earth, and the rise in temperature will be fully as great as in the case of the exposed conductor. But copper increases its resistance ·4 per cent. for each degree of rise. Supposing our lamp to have but a fourth of the resistance; with the same economy double the current would be required. If the resistance of the cable were fixed, this double current would develop four times the heat, but the increased temperature is attended by a rise of fully 30 per cent. in resistance, and the work done would be more than five times as great. Further than this, the temperature of the cable would be dangerously high.

METERS.

After many trials of various kinds of meters, or registers, Mr. Edison has adopted that which depends on electrical deposition, and has selected pure zinc for his plates, a strong solution of sulphate of zinc for the liquid, and places the register in a shunt circuit, allowing but about 1-800th of the current to pass through it. The weight of

deposited in one hour by the ampère of current is 1198·8 milligrammes. Polarisation is remarkably weak, and there is very little variation when a large number of the meters are tested together. Very careful weighing is necessary, and probably the popular desire to see for one's self what current one is using, and thus have a check on the readings of the company, could only be met, with this meter, by having a competent supervisor of the weighing who was in no way connected with the company. But in the meter economy and accuracy seem to have been the objects. Error from a change of temperature is almost entirely eliminated by a proper proportion of plates and solution, the resistance of which changes in opposite directions.

SAFETY ARRANGEMENTS.

Much has been said about the danger of fire from the introduction of electricity; but if the wires are properly laid, and means be taken to cut out a circuit, when for any reason a short circuit takes place, causing of course an instant increase of current, there is no cause for apprehension. All wires, besides being insulated, should either be run through the brick or stone of a structure or run along the walls, and covered by a moulding to prevent accidental joining of the two wires. Mr. Edison has adopted this plan. The switches have large bearing surfaces, and the contacts are broken sharply to prevent arcing. Aside from these arrangements, he has introduced a feature which is an absolute necessity, and which is now recognised essential to all systems of distribution for domestic purposes. This is a weak point in every main, derived, and sub-derived circuits—a bit of wire of lead and tin alloy, which is mounted in a plug and can be readily replaced when destroyed. In the event of a short circuit the sudden increase of current fuses this wire before it can possibly heat the copper conductors. This is, I think, one of the most admirable features in this system.

Having thus considered the principal points of Mr. Edison's system in detail, let us look at it as a whole. At the late Crystal Palace Exhibition there were about 1,075 mixed lamps distributed, all supplied by the same main conductors, and arranged in branch circuits with switches and safety plugs. These were equivalent to 840 standard lamps, and the current was supplied by twelve dynamos. One object in designing the plant was to get an independence of power such that the failure of any part would not cause extinction of the lamps. The motive power consisted of three Robey, non-condensing, double cylinder engines. Each fly-wheel gave motion to a loose pulley, which through a movable cone pulley drove a section of shafting to which were belted the dynamos. Thus the breaking of an engine would stop four machines only; two could be stopped by shifting the cone pulley, and one by throwing off its belt. This arrangement steadied the current, and minimised the effect due to any irregularity of an engine. With 70 standard lamps as the full work of a dynamo, one machine should be added to every 70 lamps added to the circuit, so that the relation of internal and external resistances should remain the same. The internal resistance was about ·017. The 12 pairs of field coils, like the machines, were in parallel circuit, making their resistance 3·46 ohms, and the external resistance was about ·17 ohms. The engines run at 120 revolutions, driving the dynamos at 1,150. The machines run very quietly, with very little sparking. In the field circuit was placed the regulator, a series of open wire coils joined to segments of a circle around which travels an arm which by successive contact throws into circuit one or more coils, thus increasing the resistance of the field circuit. By the movement of a lever the lights could be thus regulated in intensity. The eye is a very poor judge of this intensity, and to indicate an abnormal potential a magnet is bridged across the mains just as the lamp is done, and the tension of the armature spring regulated, so that when the potential increased, the increase caused the armature to move and a bell to ring. Such an arrangement, however, shows only the fact that the potential is too high, and in a larger system a much more delicate arrangement is used, the deflection of a spot of light on a graduated arc of large radius. The manual labour now used could be readily dispensed with, for the current in the galvanometer circuit can control a delicately adjusted armature, which being moved one way or the other would throw into action mechanism to operate the lever, or can close or reverse the current of a small motor, which moves the lever one way or the other. The use of the regulator should be as limited as possible, because a resistance which has no other function than diminishing a current is not to be commended, therefore very few coils should be in circuit for any length of time, and the regulator should find its office principally in meeting any sudden changes in the external resistance. The small amount absorbed in regulation, about the energy used in four lamps for a 70-light machine, cannot be objected to. Whether the shunt system, or the method of separate exciting for the field magnets will be found preferable, will probably be ascertained only after considerable experience. With but few machines in action, I think unquestionably the shunt system, with comparatively high resistance of the field coils, is by far the best. These are matters of relative economy and practice, not at all of the successful distribution of electricity. Just as small machines may be coupled in parallel circuit, so may large ones, with satisfactory results. This coupling of machines of low resistance in parallel circuit is absolutely necessary, and the only way practicable for a system of distribution directly from the generators. When so joined, loss of energy in the armatures bears precisely the same ratio to the total energy expended as exists in a single machine. Were the lights at the Crystal Palace furnished by one machine, having an armature with a resistance equal to that of one of the armatures of the small machines, there will be a loss of over 90 horse-power, enough to drive nine machines. When the machines are joined, there is the same immunity from harm in case of contact as in a single machine.

At Holborn Viaduct there are from 1,100 to 1,150 lamps furnished from the central station. The system of distribution is that of multiple arc and branch circuits. It is this question of distribution over large areas to which Mr. Edison has given a great deal of thought, and has, I think, satisfactorily solved the problem. Imagine two great sheets of copper in juxtaposition, maintained at a certain difference of potential. If in either there exists a difference of potential at any two points there will be a general flow of electricity set up to restore the plate to a state of equilibrium. If these plates be joined by conductors, currents will flow proportional to the difference of potentials and the resistance of the conductor, just as if these plates were the terminals of a machine. Let such plates be the terminals of a machine, or, better still, of several machines, and let the connections be made at several points. There would be a system of distribution, as far as regards the conductors, on the most perfect principles; and if the resistance of the connecting paths is less, that is, the number of paths greater, at one point than at another, there would be at that point a greater tendency to reduce its potential, and currents would flow to it from the surrounding parts. Perforate these plates, or replace them by networks, or meshes of cables, and we have a perfectly practicable method of providing a distribution, and I think the most satisfactory one. The way of laying down a district on this system is to lay the main cables in each street, and wherever they cross join like to like. This is to be supplied from the central station at several different points, which points are determined by the relation of the size of the conductors and the resistance of, and allowed variation in the intensity of the lamps. The direction of the current in the street conductors will not always be the same, but will change so that the maximum flow is towards the point where there is the greatest demand. The relative sizes of conductors are calculated for the maximum currents they are to carry, and in order that the percentage of loss may be the same a double current would require a conductor of double cross section. The main conductors diminish in size as the distance from the several sources of supply increase, and the several districts in the city, each being primarily fed by a single system of generators, are joined together. If one-half of these conductors were broken the remainder could still supply the district. Small wires from every part of the city can be taken to one central office so that the actual state of the potential may be known at any instant at any point, and even an automatic record kept. Thus one man can keep constant supervision over the whole system, having thus a check on the engineers, and by telephonic communication give the necessary directions to increase or lower the supply. In every dynamo room a dial can be placed in a shunt from the cable of each machine which will indicate the number of lamps or the amount of current which the machine is supplying. I have made no mention whatever of the application to power, which I will consider later. Nor have I spoken of storage batteries in connection with this system, and I think with Mr. Edison that they are not a necessary adjunct. The variation of light would be remarkably small, and the failure, as far as the street mains are concerned, is practically impossible. There then remains the question: What is the liability of break down at a central station? If there is but one such station, the only way in which it could be disabled would be the blowing up of the major parts of its boilers, and this is not very probable. The break down of a single engine, the failure of one or two armatures, is quite possible, and we may say at times probable. But such a breakage would not seriously affect the supply, for, aside from the fact that there would probably be a reserve dynamo, the machines can be easily run to over their normal power. In a city the entire destruction of a central station would not put out the lights in its own district, for the mains would be supplied from those of the surrounding districts. The calculation of the size and number of the supply and distributing means is a work of most careful engineering. It involves the cost of iron and copper, of coal and property, of labour, of capital invested and interest required—in short, how much of the energy of the coal can be wasted, and in what part of the system. So each city must be the subject of special calculation, and, although a complicated work, it is perfectly practicable.

Such is a brief *résumé* of Mr. Edison's system, as it has appeared to me after long and thorough study, a system in the fullest sense of the word—one of supply, measurement, and consumption, elaborate in detail, broad in conception. When we consider the present uses of electricity, and the uses which will be developed when it is at every householder's command, we will be more able to appreciate the importance of Mr. Edison's work, and recognise his clearness of conception and great foresight in thus practically solving the great problem of the distribution of electricity.

(*For discussion on this paper see page* 179.)

A NEW ELECTRICAL CONTACT MAKER.

[Paper read before Section A, Tuesday, August 29th, 1882, By Prof. H. S. HELE SHAW.]

THE author first calls attention to the want of an absolutely reliable and at the same time sufficiently sensitive electrical contact maker. Such an instrument is often required to measure or control the relative motion of bodies in conjunction with delicate clockwork. He then proceeds to discuss the ways in which such contact may be made. In theory there is no distinction in the modes of doing this, but practically they may be separated into—

(1.) Relative motion of the two terminal surfaces normal to both.
(2.) Motion tangential to both.
(3.) Motion compounded of these two.

These modes are separately discussed, and also the various objections with all when solid terminals are used. The use of a liquid terminal with which the other terminal being solid is brought into contact obviates most of these objections. Of all liquids mercury is the only one which can practically be employed. There are, however, two

objections to its use which have prevented its being hitherto adopted for more than temporary and experimental purposes. These are:—

(1.) The fact that it readily combines with oxygen on the passage of the electric spark.

(2.) The difficulty of making a contact maker of this kind portable.

The earliest form of instrument in which the author has endeavoured to overcome these difficulties, was then shown on a diagram and described. Its principle of action is briefly this: A short glass tube, closed at the upper end (such as an inverted test tube), is filled with mercury and inverted in a vessel of mercury. The mercury in the tube is then partially displaced by hydrogen gas. A very light bent lever, consisting of a platinum wire, passes through the mercury into the gaseous space, and there makes contact between the mercury below and a smaller quantity of mercury in an insulated capsule above the other portion, but within the tube. This lever works on a pivot, being actuated from the outside by the escapement of an ordinary clock, and is extremely sensitive in its action. The positive and negative poles of the terminals are respectively connected with the mercury in the capsule, and that in the vessel below. It is evident that although the lever is always in electrical contact with the latter, the circuit is only completed when it is brought into contact with the former. Accounts of experiments showing the satisfactory action with this apparatus are then given. Finally, the most recent form of apparatus which is portable is illustrated and described.

RECENT PROGRESS IN TELEPHONY.

[Paper read before Section G, Monday, August 28th, 1882,
By WILLIAM HENRY PREECE, F.R.S.]

THE telephone was first introduced to the British public at the meetings of the British Association. In 1876, at Glasgow, Sir William Thomson startled all his hearers by announcing the fact that he had heard, in Philadelphia, Shakespeare quoted through an electric wire, by the aid of the invention of Mr. Graham Bell, which he then pronounced to be "the greatest by far of all the marvels of the electric telegraph." In 1877, at Plymouth, I had the pleasure of showing in actual operation the finally developed instrument now known as the Bell Telephone, which I had just brought over from America, and conversation was actually maintained between Plymouth and Exeter. Five years have elapsed since then, and it is fitting that the British Association should hear of the progress made in the application of this astonishing apparatus.

In 1877, it was simply a scientific toy; it has now become a practical instrument. £1,550,000 capital is already embarked in its extension in England, and it is earning a revenue of £109,000. Hitherto it has been practically a monopoly in the hands of a private company, who hold the controlling patents, and of the Post-office, who possess the controlling power, but owing to the policy of the present Postmaster-General, this monopoly has been broken up, fresh patents have come into existence, and we are about to witness severe competition. It is often said that competition in any business will have the effect of reducing the rates charged to the public, but the experience of the past in railways and telegraphs scarcely teaches this lesson; competition does not always benefit the public. Undue competition tends to lower the rates for a time, but it eventually leads to amalgamation, to the absorption of the weak by the strong, to swollen and watered capital, and finally, in many instances, to higher rates to a too-confiding public. Competition however induces better service, and ultimately, in this respect, the public gain.

The free traffic in patents, however, leads to jobbery and speculation of the worst type. We have recently seen a mania for electric speculations that almost rivals the South Sea Bubble period. The public have wildly rushed into ill-matured schemes that have swollen the purses of gambling promoters, have turned the heads of inventors, have retarded the true progress of the beneficial application of this new science to the wants of man, and have thrown away millions upon imperfect schemes. Much has been said against the monopoly of the Post-office in telegraphic business, but it has, at any rate, the merit that it has checked the rapacity of company promoters and patent-mongers in that branch of the practical application of electricity, while no one can assert that it has checked the progress of telegraphy. During the first week that the telegraphs in this country were transferred to the State, the total number of messages transmitted was 26,000, while in the week ending August 11th, it amounted to 724,000. There is no inventor who can assert that his scheme has not received proper consideration, nor show a real improvement that has not been adopted and remunerated; while the improvements of the Post-office itself are freely adopted by other countries, and America itself, the home of the inventor, has found the advanced system of England worthy of acceptance.

Receivers.—The original telephone receiver of Bell has scarcely been improved upon; it remains in form and construction very nearly the same as that which I exhibited in 1877. The perfection of its working depends upon the truth and perfection of its manufacture. It is now more solid and substantial than it was at first, more powerful magnets are used; but still it is the same simple, marvellous, and beautiful instrument that I brought over from America. Mr. Gower has increased its loudness by varying the form of its various parts, and using very powerful horse-shoe magnets of peculiar form; but experience shows that loudness is always obtained at the expense of clearness of articulation; and, although for many purposes the Gower-Bell instrument, which is adopted by the post-offices, and is now in use to connect together all the sections of the British Association scattered through the town of Southampton, is more practical, nothing for delicate articulation surpasses the original Bell.

The Paris Exhibition of last year, so fruitful in electrical novelties, did not bring forth any marked improvement in telephonic apparatus. It was noticeable chiefly for its practical applications of the telephone, and particularly to the transmission of singing and music to a distance. M. Ader's modification of Bell's receiver is that almost universally used in Paris. It is a very handy, pretty, and convenient form. He utilises a principle which he calls "surexcitation." A thick ring of soft iron is inserted between the ear-piece and the diaphragm, and this is said to increase the attractive power of the little horse-shoe magnet upon the vibrating iron diaphragm. A simple experimental apparatus of M. Ader's shows that there is some foundation for this fact: when a thin steel spring is adjusted close to the poles of a magnet without being attracted by them, the near approach of a mass of iron to the spring will cause it to be attracted by the magnet.

D'Arsonval has also modified the Bell receiver. He has placed the coil in a powerful magnetic field of annular form, and has thereby concentrated the lines of force upon the induced coil. He brings the whole coil within the influence of the field. The effects are considerably magnified, and the increased loudness is not accompanied by the usual loss of articulation. Speech is said to be reproduced without any change of *timbre*.

Telephone receivers of the Bell type are all based upon the magnetic effects of currents of electricity flowing around magnets or bars of soft iron.

The rapid and rhythmic magnetisation and demagnetisation of a bar of iron, or the increment and decrement of the magnetism of a magnet, will produce molecular disturbances, in its own mass and in the matter about it, that lead to the oscillatory motions of the whole, which produce sonorous vibrations that can be made manifest by various devices, and particularly by that patented by Graham Bell.

Other principles of electricity have also been utilised for telephonic receivers.

For instance, Mr. Edison used the electro-chemical effect. The decomposition of a chemical solution in paper or on chalk by the passage of currents through it produces a modification of the friction of two moving surfaces, which can reproduce sonorous vibrations, and the result is a very loud-sounding apparatus. I myself had the pleasure, in 1880, of submitting to the Royal Society a receiver based on the electro-thermal effects of the current. The passage of a current through wires always heats them and therefore produces expansion. If the wire be made fine enough, the heat is generated and dissipated so rapidly, the expansion and contraction are so quick, that sonorous vibrations are the result. Although I was able to speak through it very clearly, I have not as yet developed this instrument into a practical form. Professor Dolbear has recently utilised the electro-static effects of currents. His receiver is even more simple than that of Bell. Two flat circular discs of metal are rigidly fixed very close to each other in an insulated case of ebonite. When one disc is electrified positively by a charge of electricity, the other is electrified negatively by induction. These two opposite states produce attractions varying in force with the strength of the signals sent, and the result is that, when telephonic currents are transmitted, we obtain sonorous vibrations, and consequently, the reproduction of speech.

Many other forms of telephone receivers have been devised and exhibited, in fact I have recently seen quite a crop of them; but as they involve no new principle, and introduce no particular improvement, having been brought out chiefly to try to avoid existing patents, I pass them over, and proceed to the next branch of my subject.

Our present Patent Law is, unfortunately, in so disorganised and chaotic a condition that evasion is often possible, and hence the questionable morality of doing a thing in another way in order to avoid the incidence of a royalty, is practically encouraged.

The possession of a patent is now no guarantee of property: it is granted without any discrimination, and cannot be upheld without tedious litigation and wasteful expenditure before a non-technical and scientifically incompetent tribunal. We therefore cannot hope for any virtue in English inventors or security for real improvements until our law is thoroughly revised. The question is before the House of Commons, and when wordy agitators have fully exhausted the patience of our legislators, we may hope for some attention to so real and pressing a want.

Transmitters.—The great novelty and peculiarity of Bell's telephone was that the receiver and transmitter were similar and reversible. Sonorous vibrations of air impinging on an iron disc caused it to vibrate in front of a magnet, around one pole of which a portion of an electric circuit was wound. These vibrations of a magnetic substance in a magnetic field produced currents of electricity in the coil of wire on the magnet, varying in strength and direction with the sonorous vibrations, which, proceeding along a wire to a distant station, there varied the magnetic strength of a similar magnet so as to vary its attractive force on a similar disc, by which it reproduced the motions of the first disc, and thus, reproducing the sonorous vibrations of the air, repeated speech. The currents, however, were very feeble; much energy was lost *en route*, and the effect scarcely attained a practical standard. Mr. Edison showed how to strengthen these currents. Taking advantage of a peculiar property of carbon, which was supposed to vary in electrical resistance with the amount of pressure brought to bear upon it, he caused the vibrating disc which was spoken against to press upon a button of carbon, and so to vary the strength of a current of electricity passing through it. This varying current, passing through the primary wire of an induction coil, set up in the secondary coil more powerful currents than the Bell instrument produced, and caused louder and more marked effects at the receiving station. Professor Hughes went a step further. He found a combination of materials that were directly affected by sonorous vibrations, which he called a "microphone," and he proved that the effect of the carbon transmitter of Edison was not due to any influence of varying pressure on the mass of the carbon, but was a phenomenon of loose contact. He found a new fact in nature, and

he startled the scientific world by introducing an instrument which did for minute sounds what the microscope had already done for minute objects. By the light thrown on the theory of the instrument by Hughes, Edison's carbon transmitter has been so improved by Blake, Hunnings, Moseley, Anders, and others, that little apparently remains to be done. The telephone as a speaking instrument is now well-nigh perfect. It is quite possible to swear to a friend's voice at 100 miles distance. The difficulty of making the telephone a practical instrument under all circumstances is not due to any defects in the instrument itself, but to disturbing influences external to it, and consequent on its surroundings. The very perfection and sensitiveness of the apparatus itself are its chief enemies.

The true action of the microphone, or carbon-transmitter, is very little understood: it introduces into a closed electric circuit, through which a current is flowing, a resistance which, varying exactly with the sonorous vibrations impinging upon it, causes the current to undulate in a way exactly analogous to the varying sound waves. This effect is generally assumed to be due to a greater or less intimacy of electrical contact between two semi-conducting surfaces abutting upon each other; but there is now little doubt that it is due to effects of heat generated by the passage of electricity between two points in imperfect contact, whose relative distance is variable. Carbon is the best material for the purpose—first, because it is inoxidisable and infusable; secondly, because it is a poor conductor; and thirdly, because it has the remarkable property of having its resistance lowered when it is heated—the reverse of metals. This observation is due to Mr. Shelford Bidwell.

The resistance of microphones is very variable: some only give 10, while others give 25, and some even 125 ohms. The best transmitters that I have worked with (Moseley's) give an average of 20.

Attempts have been made to apply mathematical analysis to the determination of the best form and arrangement of microphones, but at present the microphone defies mathematics.

Theory would lead to the conclusion that a carbon transmitter should have the lowest possible resistance, but practice does not confirm that idea.

Theory again asserts that the resistance of the secondary coil of the induction coil should be equal to that of the line it works, but practice proves the very reverse. On a line giving nearly 1,800 ohms resistance, the best effects were produced with a secondary wire of only 30 ohms resistance. The fact is that the conditions due to heat in the microphone, and to self-induction in the induction coil, are very complicated, and are not yet sufficiently understood to bring the phenomena they affect within the region of mathematical analysis.

Accessories.—I do not intend to speak here of the bells, calls, switches, &c., used in carrying out telephonic operations: there has been nothing that is particularly novel introduced, or that was not previously used in telegraphy. In fact, the whole operations carried on in connection with the so-called "exchange" working are simply telegraphic, and are still in a somewhat tentative condition.

Long-distance Speaking.—I have said that the difficulty in speaking is chiefly due to the environment of the wires employed. Were we to erect a wire from Land's End to John o' Groats, upon lofty separate poles and away from all other wires, there would be no difficulty whatever in speaking between those two places. Conversation has been held in America over 410 miles; in Persia it has been effected between Tabreez and Tiflis, 390 miles apart; in India, over a distance of nearly 500 miles; in Australia, of 300 miles; but in all these cases it was done either at night or under exceptional circumstances, and in all cases the wires were overground. Had they been underground or submarine, the case would have been very different. Conversations have been held between Dover and Calais, between Dartmouth and Guernsey, and between Holyhead and Dublin, but I know of no case where any persons have spoken through more than 100 miles of submerged cable. The reason of this diminution of speaking distance is due to the electro-static capacity of the telegragh line, which absorbs the minute quantity of electricity that makes up the currents employed for telephonic purposes.

In every submarine cable, before a signal can be made at the receiving end, the whole cable must be charged up with electricity, and if there be not sufficient electricity sent in to effect this purpose, practically no signal appears at the distant end. With telephone currents on long cables the whole of the electricity is, as it were, swallowed up—that is, none appears at the distant end, or, if it does appear, it is rolled up in one continuous wave, bereft of those rapid variations that reproduce sonorous vibrations. The newspapers said that the sound of the bombardment of Alexandria was heard at Malta; but, in the first place, the experiment was not tried, and, even if it had been tried, it could not have succeeded. The use of underground wires very seriously impedes telephonic extensions, and with our present apparatus and present knowledge we cannot readily speak over greater distances than 20 miles.

Disturbances.—But there are other disturbing influences at work of more serious import.

When two or more telephone wires run side by side, what is said on one can be overheard on all the others; and when a telephone wire extends alongside telegraph wires, every current on the telegraph circuit is repeated in the telephone, leading to a hissing, frying, bubbling sound that is not only very irritating, but which on busy lines entirely drowns speech. When music is transmitted on one wire, it can be heard equally well on all wires running parallel and contiguous. This is due to induction and to leakage.

(A.) *Induction.*—Induction is a term employed to designate the peculiar influence which electrified and magnetised bodies exert upon conducting and magnetic masses in their neighbourhood. If two wires run side by side for some distance, every current of electricity sent upon one wire will produce two currents in the contiguous wire, the one at the commencement and the other at the end of the primary current of electricity. The greater the intensity, and the more sudden and abrupt the commencement and the ending of the inducing the greater effect it has on the induced wire. Those instruments, consequently, which reverse their currents the most rapidly and suddenly, produce the greatest disturbance. The powerful alternative and intermittent currents used for certain electric light systems are death to telephones: they cause an incessant roar that renders speech an impossibility. There are some apparatus in telegraphy that require very powerful currents to work them, which are equally detrimental. Many attemps have been made to cure this evil.

1. The sensitiveness of the receiver has been reduced to lessen the influence of the disturbing currents, and the strength of the telephonic transmitting currents has been increased so as to overpower the induced currents.

2. The influence of one wire on the other has been screened off by inserting metal coverings in connection with the earth between them.

3. The suddenness of the rise and fall of the inducing currents has been modified by the insertion of condensers or electro-magnets.

4. Counterbalancing or neutralising effects have been set up by counter-induction apparatus.

But all these plans, and many others, have been proved either only partially successful or wholly abortive; the only effective mode of curing the evil at present practically used is to employ a complete metallic circuit, so contrived that the two wires are in very close proximity to each other, or that they twist round each other, so as to maintain a mean average equality of distance between themselves and the disturbing wires. When we have the two wires of a circuit kept at the same mean distance from the disturbing causes, however near they may be, the influence on each must be identically the same, and as the one is used for going and the other for returning, the similar influences must be opposite in direction, and they must therefore neutralise each other. This plan, which was originally devised for underground wires by Mr. Brookes, of Philadelphia, was found to be absolutely true in practice, and the Post-office, having laid down many hundreds of miles on this system with perfect success, invariably constructs its circuits both underground or overground in this way. It is, of course, more expensive than a single wire, but the great gain—the absolute freedom from overhearing the privacy, and the absence of crackling—is well worth the extra cost. Wires in submarine cables are invariably laid up with a twist, so that no special contrivance is needed on such wires, and in underground wires not laid up together as cables, they are, as a rule, so close to each other that twisting is unnecessary; but for overground purposes twisting is essential, and special arrangements have to be carried out. Professor Hughes showed how this was to be done, and Messrs. Moseley carried it out practically in the neighbourhood of Manchester. The plan adopted by the Post-office for *two* and for *four* wires is shown by the diagram. It is simply and easily carried out, and entails no practical difficulty whatever.

In the neighbourhood of Manchester there are over 400 miles of overground double wire twisted on this plan, working efficiently and thoroughly. I have spoken to a friend 76 miles off, through wires that were erected on poles carrying busily-occupied telegraphic currents, without disturbance or difficulty.

(B.) *Leakage.*—The double-wire system is only absolutely effective so long as the insulation is good. The moment insulation fails, connection with the earth is made, and then we have disturbing causes, due to currents flowing through the ground, which are increased in proportion to the deterioration of the insulation. Hence, good insulation is essential to telephone working.

The discovery of the telephone has made us acquainted with another phenomenon. It has enabled us to establish beyond doubt the fact that currents of electricity actually traverse the earth's crust. The theory that the earth acts as a great reservoir for electricity may be placed in the physicist's waste-paper basket, with phlogiston, the materiality of light, and other hypotheses. Telephones have been fixed upon a wire passing from the ground floor to the top floor of a large building, the gas pipes being used as a return, and the Morse signals sent from a telegraph office 250 yards away have been distinctly read; in fact, if the gas and water systems be used, it is impossible to exclude telegraphic signals from the telephone circuit. There are several cases on record of telephone circuits miles away from any telegraph wires, but in a line with the earth terminals, picking up telegraphic signals. When an electric light system uses the earth, it is stoppage to all telephonic communication in its neighbourhood. The whole telephonic communication of Manchester was one day broken down from this cause, and in the City of London the effect was at one time so strong as not only to destroy telephonic communication, but to ring the bells. A telephone circuit using the earth for return acts as a shunt to the earth, picking up the currents that are passing, in proportion to the relative resistances of the earth and the wire. The earth offers resistance, and consequently obeys the law of Ohm: hence it is not only essential for a telephonic system that the earth should not be used on any electric light system, but it is also desirable that the earth should be eschewed for telephonic purposes. Thus, the double-wire system adopted by the Post-office and by the Société Générale des Téléphones of Paris, not only cures the ill-effects of induction, but it materially diminishes the disturbing influences of earth conduction. The four-wire system of the Post-office effectually checks leakage from one wire to the other, cross contact, as we call it in England, for each wire of the same current is always on a different supporting arm.

A telephone circuit when in connection with the earth gives distinct evidence of every visible flash of lightning, however far off the thunderstorm may be. No difference in time has been observed between seeing the flash and hearing the crash.

It is said that if a telephone be connected between the gas and water systems of a house, distinct evidence of every flash can be heard. There have been several cases of persons being knocked down while experimenting during a thunderstorm, but no personal injury has been sustained, although the apparatus itself [illegible] quently damaged. In England, at present, we have not found damage done sufficient to justify the employment of li[illegible]

protectors. The use of double wires diminishes the danger to a minimum. On the Continent and in America, however, telephones are invariably protected by lightning arresters where one wire only is used.

There are certain natural currents flowing through the crust of the earth. They are called "earth" currents, and at times acquire such considerable energy that with a telephone pressed to each ear, I have been told, although I have not experienced it, that the noise made is as though "your brains were boiling." This is due to the intermittent currents produced by the polarisation of the earth plates.

M. Van Rysselberghe has recently spoken between Paris and Brussels upon a wire nearly 200 miles long, which was used at the same time for ordinary telegraphy, but the experiment was made early in the morning (4 a.m.), and was effected by retarding the telegraphic currents, so as to modify the suddenness of their rise and fall, by means of condensers and electro-magnets. I am unable to understand the advantage of any gain in speaking on a wire which is detrimental to telegraphic communication. Speed is of more importance than speech, and we can telegraph much faster than we can speak. In England speed is everything, and we eliminate every influence that retards speed—condensers and electro-magnets in telegraph circuits are out of the question. M. Van Rysselberghe has endeavoured to extend the idea to cure the effects of induction by destroying the main cause of the disturbance—that is, by reducing the sudden rise and fall of the prime telegraphic currents; but to do this means to retard telegraphy, and we cannot afford in England to cripple the one system in order to benefit the other.

I have recently tried an extremely interesting experiment between this place (Southampton) and the Isle of Wight, namely, *to communicate across seas and channels without the aid of wires at all.* Large metal plates were immersed in the sea at opposite ends of the Solent, namely, at Portsmouth and Ryde, six miles apart, and at Hurst Castle and Sconce Point, one mile apart. The Portsmouth and Hurst Castle plates were connected by a wire passing through Southampton, and the Ryde and Sconce Point plates by a wire passing through Newport; the circuit was completed by the sea, and signals were passed easily so as to read by the Morse system, but speech was not practical.

The telephone is very rapidly gaining ground, and as improvements are effected in its accessories, in its installation, and in its mode of working, its use will still further extend. In Germany it is used very extensively for telegraphic business, there being 1,280 stations worked entirely by telephones, but in England it is not possible in the numerous open and public shops employed as post-offices to secure that privacy which the telephones require, nor have we yet got over our early prejudices, resulting from the errors made through the inability of the instrument in its earlier form to repeat the sibilant sounds. The instruments of the present day (thanks to the improved transmitters), however, transmit "s's" perfectly. By Mr. Smith's inductophone it is quite possible to make use of air between us to hear perfectly; so that air conducts sound, so does water, so does wire, and indeed with our present knowledge our difficulty is not so much to make things speak as to prevent them from speaking.

THE DEMANDS OF A SYSTEM OF ELECTRICAL DISTRIBUTION.

[Paper read before Section A, Friday, August 25th, 1882, By F. J. SPRAGUE, U.S. Navy.]

IN order to more fully understand the subject of incandescent electric lighting, let us consider the requirements graphically. I hardly need to argue that the multiple arc system is preferable to that of the series, and is in fact the only admissible one which can have any wide application. In fig. 1, let M be the generator, p and p' the terminals, R, R', R'', R''' circuits in multiple arc or parallel circuits; in other words, derived circuits from the same terminals. Now it matters not what the resistance of the machine, or the number, or resistance of the derived circuits, if they be connected to the same terminals, the current in any circuit will be equal to the difference of potentials at the points, p, p', divided by the resistance of the circuit in question. Nor does the addition or subtraction of any number of circuits make the slightest difference in the currents flowing in the circuits already established if this difference of potentials, $p - p'$, is kept constant. Consequently, the currents over the different paths will be inversely proportional to their resistances, and perfectly independent of each other. Since the external resistance diminishes with the increase in the number of the derivation circuits, the whole current flowing from the terminals will vary inversely with the external resistance. But the whole current is the current flowing through the armature. Since the internal resistance enters as a factor, although the difference of potentials at the terminals remains constant, the electromotive force of the machine does not. Let us consider a machine which, with an external resistance equal to the internal a, a given velocity and strength of field current, generates an electromotive force, ϵ. Call the external resistance $a\,r$, i.e., some ratio r of the internal, and let the current in the field magnets, independent of the current generated, or the velocity, or both, be changed as the external resistance changes, so that the difference of potential at the terminals may remain constant. Consider the change in the electromotive force of the generator. We have for two external resistances, one, a, equal to the internal, another, $a\,r$, greater or less, two currents.

$$c = \frac{\epsilon}{2a} \quad \text{and} \quad c^1 = \frac{\epsilon^1}{a(1+r)}$$

whence

$$\frac{c}{c^1} = \frac{\epsilon\, a\,(1+r)}{2\,a\,\epsilon^1} = \frac{\epsilon\,(1+r)}{2\,\epsilon^1}$$

But by condition of working

$$\frac{c}{c^1} = \frac{a\,r}{a} = r$$

$$\therefore \quad r = \frac{\epsilon\,(1+2)}{2\,\epsilon^1}$$

$$i.e., \ \epsilon^1 = \frac{\epsilon\,(1+2)}{2\,r} = \frac{\epsilon}{2}\left(\frac{1}{r}+1\right)$$

Differentiating this last equation with ϵ as the unit of electromotive force and ϵ^1 and r variables, we have—

$$\frac{d\,\epsilon^1}{d\,r} = -\frac{\epsilon}{2\,r^2}$$

and

$$\frac{d^2\,\epsilon^1}{d\,r^2} = \frac{\epsilon}{r^3}$$

which give the character of the curve of electromotive force under the conditions assumed. Fig. 2 gives the curve, with r and ϵ^1 as the

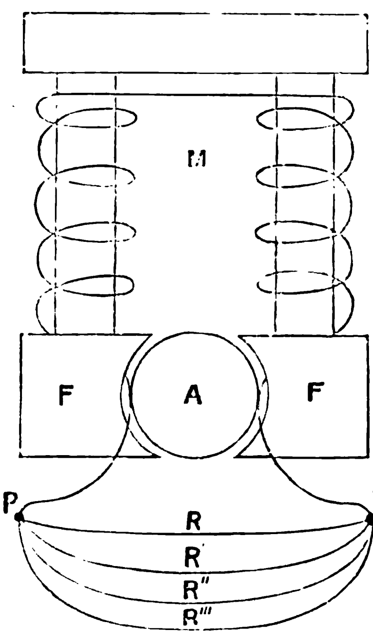


FIG. 1.

co-ordinates, x and y, with the bend near the origin, and with branches having for asymptotes the axis of y, and a line parallel to the axis of x, and distant $\frac{\epsilon}{2}$ from it. Vertical lines on to the axis of x represent the electromotive force compared with the unit, ϵ, which may

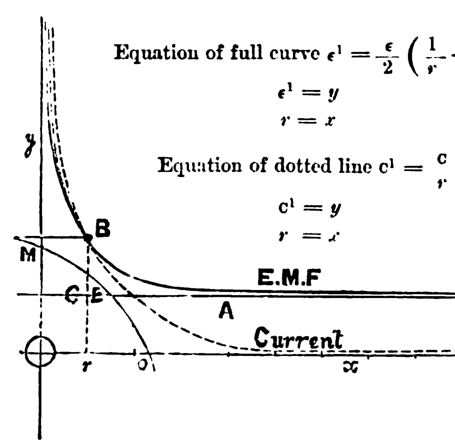


FIG. 2.

be of any number of volts, and the distance from the origin the ratio of the external to the internal resistance. This curve shows some important truths, a part of them familiar, others perhaps not so, concerning the economy and practice of the distribution of electricity, or the supplying of currents which will be inversely proportional to the resistance of the derived circuits, remembering meanwhile that the electromotive force of a machine excited by a separate circuit is very nearly proportional to the strength of the free magnetic field and the velocity of the armature. Of course this is somewhat affected by the heating of the metallic conductor for an increased current, the consequent change of resistance, the displacement of the magnetic field, and the heating of the iron part of the armature, if iron enter as a component. We notice

1. In a single generator the electromotive force is not proportional to the number of lights or motors, or the current developed.

2. No matter how high the external resistance, or how limited the number of derived circuits, the electromotive force of a machine required to maintain a fixed difference of potential at the terminals can never be less than half that developed when the external and internal resistances are equal.

3. The increase of electromotive force required as the external resistance decreases, or the number of derived circuits is increased, is very gradual up to the point where the external resistance is three or four times the internal, beginning then to rise more rapidly.

4. When the external resistance falls below the internal, the rise is very rapid, and if their difference is marked, then it becomes impossible to maintain a fixed difference of potential, because of the great increase necessary in the strength of the magnetic field and the velocity of the armature. A great amount of heat, and consequently of wasted energy, would be developed in the armature.

Let us consider another curve. Our requirements demand that the whole current should be inversely proportional to r, the ratio of external to internal resistance, or C being the current developed when the electromotive force is ϵ, $C^1 = \frac{C}{r}$. Let this curve be traced on the same axes as the preceding, and let the same unit of measure be used for C as for ϵ. (See dotted curve in fig. 2.) We find the curve somewhat similar to the curve of electromotive force; but it approaches both axes as asymptotes and falls rapidly below the first curve on the right, while rising above it on the left. A glance shows the relations of current and electromotive force for different ratios of external to internal resistance.

Note one curve more on the same sheet, though not with the same units; the curve of magnetic strength (M) is measured here vertically, the increase of field current being measured horizontally and to the left. The strength of the magnet increases at first quite regularly; the curve, however, flattens more and more as the current increases, until at the point of practical economic saturation a large further increase of the field current would produce but a much smaller ratio of increase of magnetic strength. Part of the energy of the increased current would undoubtedly manifest itself in heat both in the coils and in the iron of the magnet.

Now in a general distribution of electricity, a large number of derived circuits existing, there must necessarily be a low external resistance. Large currents flow through the generator, and we wish to have the energy of the current in the external circuit and not in the machine. It has often been said that the external resistance being thus reduced, the resistance of the individual lamps should be as high as possible. This is not so, for certain relatives exist between the weight and resistance of carbons, the illuminating surface, the electromotive force and current required, and the energy expended, which determine a limit. The expression for the work done is $\frac{\epsilon^2}{R} \times 44{\cdot}24$, or C^2 R, $44{\cdot}24$. Hence, with a given electromotive force the work done varies inversely as the resistance, and with a given resistance the work varies as the square of the electromotive force or the square of the current. If we increase the resistance to any ratio, d, of a given resistance, to maintain the same expenditure of force, we increase the electromotive force, but only in the ratio $\sqrt{d}$; so that with four times the resistance only twice the electromotive force would be required. Consider for a moment the size and shape of the carbon. If a carbon of circular form be used, the same weight would enter in a piece of half the diameter and four times the length of a given piece, giving sixteen times the resistance and twice the illuminating surface. With half the weight, we have the same surface and eight times the resistance. If the same energy be expended there will be necessary $\sqrt{8}$ times the electromotive force used with the coarse carbon, but $\frac{1}{\sqrt{8}}$ of the current. This would mean that with the same lamp expenditure for given illumination, one ton of coal would be used on the conductor for the high resistance lamp to eight tons for the low resistance one, a strong argument in favour of high resistance carbons.

Our first conclusion would then be to diminish the diameter and increase the length and resistance of the carbon, meeting this increase by an increased electromotive force. But in a system of general distribution, safety from fire, due to piercing the insulation, abnormal increase of current when short-circuited, and immunity from harm when by any accident the body forms a part of the circuit, demand a low electromotive force. Sir W. Thomson has said that this should never exceed 200 volts. Even this will give some persons a disagreeable shock, and a lower electromotive force may be used with advantage. Another point of consideration is the increasing of the resistance of a carbon while the length, diameter, and weight remain constant. As before, we see that the electromotive force must increase as the square root of the ratio of increase of the resistance, and this resistance must be determined by the limit of electromotive force, the size of carbon that can be manufactured, and the degree of illumination required. We will call this carbon, the carbon of smallest section, highest resistance, and standard illuminating power, the standard lamp. Now, while we have this standard, it is evident that we want to be able to increase the power of illumination at sundry points, and this must be produced, not by a corresponding increase of intensity per unit, but by an increase of the illuminating surface, and the increase of energy expended should be in no greater ratio than the increase of light. These remarks are partially founded on the fact that an increased temperature shortens the life of a lamp, and that the most reliable results are to be obtained by having carbons for all degrees of power of the same texture, and made by the same process as the standard, which standard should in every way be as near perfect as possible; all such carbons to have the same weight, length, degree of carbonisation, resistance, requiring the same electromotive force and expenditure of energy. For the lamps of higher power, we manifestly cannot use a carbon of greater length and correspondingly higher resistance, for this means a higher electromotive force, which is out of the question. Nor can we economically increase the diameter of a circular section carbon, for the resistance diminishes inversely as the square of the increase of the illuminating surface of same intensity. There are three ways where each lamp should be independent. One is by increasing the number of carbons in a lamp, they being arranged in parallel circuit; another by increasing the width of the carbon while the thickness remains the same—in other words, use a flat carbon, so that the illuminating surface will increase in the same rate as the weight of material. Now, with a double illuminating power we use the same texture of carbon, the same temperature and intensity per unit of surface, double the illuminating surface, one half the resistance, the same electromotive force, double the current and double the energy. A third method is that the carbon can be increased in length, while its resistance per unit of length and section is diminished.

Aside from the energy expended in the lamps and motors of a circuit a certain amount goes into the generator to magnetise the field magnet, and this is represented by the same expression we have already used where the difference of potential at the terminals of the machine and the resistance of the field coils enter as factors. There is another expenditure in the armature coils and the conductors dependent on their resistance and the current flowing, and still another at the commutator, which would be greatest with large currents. The friction of bearings, the slipping of belting, if used, the force necessary to overcome the inertia of moving parts consume a further portion of power. Of these components, which are over and above that power which is expended in the lamps and motors, those which magnetise the field, and overcome the friction of bearings and the inertia of moving parts, remain about the same whether one lamp or a thousand are in operation. This is considering the kind of machine I think necessary in a system of general distribution in which this extra work should be chargeable to a large number of lamps.

Consideration of the above and some other points, which will be obvious on mention, lead me to the following conclusions.

1. The resistance of the armature of the generator should be as low as possible compatible with the power necessary to furnish the required electromotive force.

2. The generator should be able to produce this electromotive force with the field magnets at less than the maximum economic saturation, and at a velocity less than that at which the armature can be safely run, in order that there may be a margin for increased efficiency in case of an unexpected demand.

3. The lamps and motors should have a high resistance, the standard lamp not higher than 475 to 500 ohms.

4. The resistance of the conductors should be as low as practicable, and should be graded in size for the current required.

5. The electromotive force of the generator should never rise to over 170 volts.

6. The lamps should be simple of construction, durable and cheap, and all alike.

7. The generator and the engine should be of the most substantial construction.

8. The points of derivation should all have, and all be maintained at, the same difference of potential as nearly as possible.

9. The energy necessarily lost in the armature and conductors of any fixed resistance for lamps of the same absolute economy varies inversely as the resistance of the lamps, or as the square of the current used.

10. Since in a single generator the total power used is not proportional to the number of lamps in circuit, a machine should be run nearly to its maximum capacity.

11. There should not be a single generator or a single circuit which may be destroyed, but such an arrangement that the external demands, both with regard to resistance and current required, may be met by suitable changes in the resistance and supply of the generative system.

12. The relation of internal and external resistance should be the same in a system as exists in a single generator when worked to nearly its full capacity.

13. With such proper relations of internal and external resistance the electromotive force will vary but slightly, and the power used will be very nearly proportional to the number of lamps or the current developed.

14. Insulation of conductors and of the armature should be good, and provision made to prevent fire arising from an abnormal increase of current.

15. Means should exist of accurately measuring the current used.

16. A large system should be as economical as a single generator worked nearly to its full capacity, and should be capable of regulation with the same ease.

Much has been said about the sub-division of the electric light and the current, and such sub-division of electricity has been the great bugbear in the distribution of power and light through its medium. This term, while conveying an idea, is in reality essentially wrong. It implies the existence of a current, the expenditure of energy, before the required sub-division of such current is made. We do not wish to sub-divide a current; a current which must be divided before it can be used is not a desirable current.

If we had a reservoir of water dammed up to a certain height, and tap it at the depth, say, of 20 ft., a stream of water will issue proportional to the depth of water and the size of the orifice, and the amount of water flowing in a unit of time will be constant if the height of the water above the outlet be kept the same. By damming up the water we have established a certain potential, but there is no flow of water, no current, and consequently no supply until the orifice is made. Such orifice, aided by the potential of the water, in itself establishes a flow, creates the necessity for a supply. If we make another, a larger outlet, a larger amount of water will issue, and the amount in the first will not be changed if the height of the water remain constant. By opening this second channel we created an additional current, the necessity for a further supply, but such necessity, such flow did not

exist until the creation of the new demand. Our reservoir may be large, our source of supply may be great, but if a sufficient number of openings be made, both reservoir and supply will be fully used, and while expensive for a single channel will be economical for the whole.

So it is in the distribution of electricity. A current is a function not alone of potential, but of potential and resistance. We desire to establish a certain potential, or difference of potentials, and to maintain this so that when a circuit is established, a channel opened, a current may be established in that circuit. We do not divide a current, nor a potential, but having established a difference of potential in two conductors, we open one or more paths, and a current flows over these paths dependent on their resistance, and independent of each other, and such additional current having been formed, the current over the main conductor is increased by just such increment, which increment did not exist until the new path was made. There has been no sub-division of a current: there has been a creation. Such new current having been made, of course more power must be supplied to maintain the existing potential, and while the system may be expensive for a single lamp or motor, when the number of derived circuits becomes sufficiently numerous, it will only be what is required for an economic and efficient supply.

I will now consider the Edison system in the light of the foregoing conclusions. (See page 172.)

CRITICISM OF THE EDISON SYSTEM.

(*Continued from page* 174.)

In the discussion which followed the reading of this paper, Prof. S. Thompson said that while the paper just read embodied a very extensive amount of details and of principles known to electricians, he must say that he was astonished to hear it stated that there was a scientific prejudice against large dynamo machines. He had never met with it, and he believed that the feeling was all the other way. He also did not quite understand what Mr. Sprague meant by "magnets of greater projective powers." The expression was new to him.

Mr. Sprague stated that he simply meant the field power of the magnets.

Mr. Swan rose to express his pleasure at having received such a very full and excellent description of distribution in every detail. He did not feel disposed to take exception to the general principles laid down as to the mode of effecting that distribution. It was certainly done in the simplest way by connecting lamps in arc system. They were certainly now subject to the limitations as to a distance, so distinctly pointed out by Mr. Sprague; but we might emphasise the conditions of such distribution by showing that the difficulties would be lessened by making the filament as fine as possible, so as to obtain the utmost resistance consistent with, say, a 10-candle limit. But when that resistance had been obtained by diminishing the diameter and increasing the length—the light remaining constant—there was still a resistance in the lamp (?) which limited the extent to which distribution might be carried to a lamentably small area—a mile, or something like that. This was a regrettable limitation, but he saw no escape from it with the construction of the lamp. They had a fixed material—carbon—to deal with; they could not alter its specific resistance much, so that they were very much restricted in the extent of their distribution. The only escape from that limitation lay in having secondary batteries at stations or in every house, and in these batteries being connected in series and fed by currents of a higher tension; the principle still holding of multiple arc not from the central station, but from the subsidiary one at which the batteries are charged. Once imagine the possibility of these secondary batteries being maintained at a perfectly constant condition of charge by some automatic arrangement, and we might look to that as a means of escaping from the difficulties of wide distribution. It would only require that each lamp should be provided with an automatic arrangement for maintaining continuity of circuit. Such might be of an exceedingly simple character without adding much to the expense of the lamp. It might be a permanent thing, not to be renewed as often as the lamp, and under such conditions one saw no limit, supposing the lamps could be fed in series to the extent to which distribution might be extended. The only conditions necessary would be the maintenance of the lamps in a condition of equality of light, that the current should be kept constant, and that there should be automatic arrangements for varying the electromotive force at the station in proportion to the number of lights operating, whether one or 1,000. To avoid the use of a very high potential in such a system of feeding in series, the resistance might be very considerably reduced by variation of the internal sectional area of the carbon by using short and flat carbons. He might simply mention the alternative method as a comment upon Mr. Sprague's very positive assertion that they were shut in to the one system of feeding the lamps in multiple arc. He was perfectly ready to allow that that method was the only one in use, except to a very limited extent; but still they must not lose sight of the power of wider distribution which they should obtain by either the entire series feeding of lamps or the use of the series method, with the charging of secondary batteries and there feeding from multiple arc. He felt it was very desirable that they should, by some means or other, see their way to a wider extension, even with all the conditions of low resistance in the armature, which Edison had carried to an extraordinary degree, and high resistance of the carbon. They still had a limited area of distribution, with undue cost. With regard to the dynamos, it was quite an error to say that there was any prejudice as to large dynamos. He had been delighted to see the success of Mr. Edison's efforts in the construction of large dynamos. Mr. Sprague had referred to the use of a shunt current, when less than the whole number of lamps were lighted. It was evident that the same current would pass through the shunt whether few or many lamps were lighted, and evidently the loss would be somewhat greater when only a few lamps were being operated. Reference, too, had been made to the limit to the use of high resistance in the car bon, consequent upon the limit constituted by the tendency of the discharge to take place between the terminals, when there was a great difference of potential between them. That was a difficulty which was to a very considerable extent met by removing the terminals to a great distance, and he did not think that that would be found to constitute a very serious obstacle in the way of an extension of the system.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

S. A. VARLEY'S CARBON LIGHTNING PROTECTORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I think it might interest some of your readers to know that I have had 110 of S. A. Varley's carbon lightning protectors (which are referred to in the leading article of the ELECTRICAL REVIEW of the 19th instant) in use in connection with Tyer's train signalling instruments for many years, and that I have not had a case where lightning has damaged an instrument to which a carbon protector is connected.

Seventy-three of these protectors were put in use in February, 1867, and thirty-seven in March, 1872.

I am, Sirs,

Yours faithfully,

F. T. J. HAYNES,

Telegraph Engineer and Superintendent,
B. and E. Division, G.W.R.

Taunton, *August 26th*, 1882.

MAGNETIC UNITS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—As a paragraph in your paper for August 26th, p. 156, headed "Magnetic Units," might possibly lead a casual observer to think that the idea of my instrument was taken from Prof. Silvanus Thompson, in order to show that this is not the case, I wish to quote a few lines from a very kind letter to me from Prof. Thompson. They run thus: "And it will give me much pleasure whenever I do publish an account of my instrument to mention that the same idea occurred independently to you. I have not used the mirror arrangement in connection with my instrument, so that application is exclusively yours."

These few words will, I think, quite do away with what otherwise might introduce an error.

Yours faithfully,

FREDERICK JOHN SMITH.

Taunton, *August 26th*, 1882.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your correspondent "Injustice" says I have "a little more of *law* than of *justice* in my composition." He admits, then, that I have both law and justice in my composition; and I am well pleased with his admission, especially as the statement which I laid down with an "airy authority" is simply a repetition of the decision rendered by Mr. Justice Fry on the law, "that any transmitter combining a diaphragm with a tension-regulator is clearly an infringement of Edison's patent."

The remarks of "Injustice" in regard to Anders' transmitter seem to me to show, on his part, a want of knowledge of the English language, and of its phraseology. My assertion was, "that *any* transmitter combining a diaphragm with a tension-regulator is an infringement of Edison's." I did

not mean to assert that any of the parties named had made a transmitter; but if they or the man in the moon had made a transmitter "combining a diaphragm with a tension-regulator," such a transmitter is an infringement of Edison's, as decided by Mr. Justice Fry and Lord M'Laren. I fail to see the justice of "Injustice" in introducing the Reis transmitter of 1861 into his reply to me, because I made no reference to Reis's instrument. His object, however, is obvious—namely, to ventilate his *opinion* obout the Reis transmitter as being different from the opinions expressed by Sir Frederick Bramwell and other witnesses before Mr. Justice Fry in regard to the Reis transmitter, which, Sir Frederick said, "did not act as a tension-regulator."

Every one has a right to have an opinion on any subject, although he may enjoy a blissful ignorance of that subject. There seems to me to be a wide difference between the importance to be attached to an opinion, and that to the solemn judgment of the High Court of Justice.

In my letter I did not express any *opinion.* I now merely recite the words of the decision of Mr. Justice Fry, who did not think it had been established "that Reis's transmitter combined a diaphragm with a tension-regulator."

I confess that I have a very clear opinion on this matter, but I will not presume to ventilate it in the face of Mr. Justice Fry's decision; but I do express a strong desire that the question will be taken before a higher and the highest court, so that it may be finally settled whether Reis's transmitter of 1861 is an infringement of Edison's of 1877. Perhaps "Injustice" may have embraced the opportunity to pay a *well-merited compliment ! ! !* to the great patentee of patents with hundreds of specific claims for old well-known devices.

JUSTICE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—With due deference to the "editorial chair" I take leave to say that there is criticism and hypercriticism. To this latter it seems to me that your remark upon my using the words "inductive action" belongs. It must have been evident to you that I quoted these words from Bell's specification, as also from the evidence given by the eminent electrician, Sir Frederick Bramwell, and also that it was necessary for me to use those words to elucidate in a clear manner the claim of Bell, in contradistinction to my claim, and I thereby did not "erroneously consider" "inductive action" to be synonymous with "induction." Inasmuch as eminent electricians and a learned judge have used the term "inductive action," would it be amiss for you to clearly define the distinction between "inductive action" and "induction" for their benefit?

Yours as ever,
W. C. BARNEY.

53, Bernard Street, Russell Square,
August 29th, 1882.

[We were, perhaps, a little unfortunate in attributing to Mr. Barney the words made use of, also in our use of the term "induction," "*direct* inductive action" would, perhaps, have better explained what we meant. The movement of the plate in Mr. Preece's telephonic receiver is certainly caused by "inductive action," although the action is not *direct*. "Inductive action" we take to mean "an action caused by inductive effort." When we speak of the wheel in a steam engine being moved by the action of the piston, we do not mean that there are no cranks or connecting rods between the two. The material of a diaphragm or disc may not in itself be capable of *direct* inductive action, but may be actuated indirectly by inductive action.—EDS. ELEC. REV.]

CITY AND GUILDS OF LONDON INSTITUTE TECHNOLOGICAL EXAMINATIONS, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—It is with reluctance that I again ask a portion of your space to continue a discussion already outside the range of utility; but there are one or two points which I should like to notice before it is closed.

I would thank "The Student" for his testimony to the value of a theoretical and practical training. I did not for one moment suppose that his knowledge was "examinational," because three years ago I made myself acquainted with the admirable teaching at Cowper Street, and I have no doubt had he been subjected to a *practical* examination his position would have been equally distinguished.

"A. C. S." suggests that my friend's abilities are microscopic. They certainly are not. He is intelligent, familiar with principles which underlie the Duplex, Quadruplex, and other systems of telegraphy, and has on many occasions ably assisted his fellows in their telegraphic studies. He gained a first advanced prize for electricity and magnetism, and has read a good deal. My other friend knows little of mathematics and less of dynamics, and his chemical knowledge has been gained from Preece and Sivewright's "Handbook of Telegraphy."

"Maga" is right when he says there is a great temptation to try for the highest place at once. Our hours are irregular, and we can but ill spare time and money on a study so lightly valued. Our opportunities of acquiring a thorough knowledge are prescribed, as we are prohibited from examining the apparatus we work; there are but few amongst ourselves able and willing to teach "the young idea how to shoot," and when such an one appears for a little are we to be blamed for attempting to reach the goal at a bound? From our superiors we receive, instead of the smile of approbation, the frown of disapproval, and when two or three of us combine for mutual assistance obstacles are put in the way of our meeting. Let the heads of our department announce unequivocally that they desire and will recognise technical knowledge, and for every one who now attends the classes of the Guilds there will be a dozen. "Maga" says, "the questions set for the May examination were specially directed against 'cram,' and no student who had not combined a practical with a theoretical study of the subject could have answered them satisfactorily." For example:—

"Point out the difference between conduction and induction across air in a thunderstorm?"

"To whom are we indebted for the introduction of telegraphy into practical use, and when?"

"Describe the modern system of electrical measurement and detail the different units in use?"

"Describe Bell's telephone and show how speech is reproduced at a distance by its agency?"

Verbum sat sapienti!

This gentleman says, "Your correspondent goes on to state that such a course (theoretical and practical) cannot be gone through at the City and Guilds classes." If he will refer to my letter he will find I did nothing of the kind. I asked "if students more ambitious to win prizes than gain genuine knowledge, and teachers more anxious to increase their incomes than impart lasting instruction, would give to practice the attention it deserves."

The cry of "Aba" about calling in question the quality of his own or *protégé's* knowledge can be appreciated when we know that the particulars of the case cited by me "tally exactly" with those known to him.

Qui se sent galeux se gale!

Nothing has been advanced against my plea for a practical examination to go along with the written one. I believe the day is not far distant when steps will be taken by the City and Guilds Institute to test the progress in practice of those attending their classes, and so still further promote the usefulness of the work they have so well begun.

Yours truly,
FAREHAM.

THE PILSEN-JOEL AND GENERAL ELECTRIC LIGHT COMPANY, LIMITED.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your somewhat unfavourable notice of the Pilsen-Joel and General Electric Light Company, Limited, which appears in your current issue, has evidently been written without previous inquiry. I have had the pleasure of showing you over the company's factories since your notic[illegible] was written, and I think you will admit that consider[illegible], progress has been made in the short time that has e[illegible]such since the company was formed, and also that the engin[illegible] flow, [illegible] larger portion of the company's work is satisfactory. [illegible] in the

I have pleasure in informing you th[illegible] the [illegible] constant. mulator, obtained by myself for the company, pr[illegible]current, the a great success; and when the very large pric[illegible] flow did not

companies have paid for accumulators, and the merely nominal price asked by my co-patentee (I having given my share to the company), I think you will also admit the company's prospects are in every way favourable.

I will conclude by reminding you of the many notices of orders and work in hand you have from time to time published in your journal; in the number in which your criticism appears two fresh orders are noticed.

I am, Gentlemen,
Your obedient servant,
HENRY F. JOEL.

August 27th, 1882.

[In reply to our correspondent's letter, which we are pleased to insert, we assure him that our "note" was *not* written without previous inquiry and due consideration. We derived considerable satisfaction from our visit to the Pilsen factories, and can congratulate Mr. Joel on the energetic manner in which the various departments have, under his direction, been planned and fitted up. As far as the factory is concerned no fault can be found, it being a subject rather for praise. We cannot see that the addition of the new accumulator mentioned by our correspondent can affect the prospects of the company in either direction. It would appear that this fresh acquirement is either of little value, or that Mr. Joel has been exceedingly generous. However, engineering work and commercial ability are not synonymous terms. In respect to the latter portion of his letter we will ask: Is it true that Messrs Brindley and Co. have countermanded their orders, or that Messrs. Crisp, of Holloway, have intimated their desire to have the Pilsen-Joel Company's system removed? Is the company in a position to do its own work, or does an intermediate firm influence the company's operations? Perhaps one of the directors could enlighten us on this point. How is it that various concessions have fallen through? For what reasons did the assistant-engineer of the company resign his engagement over the Liverpool installation, and is it a fact that their energetic commercial representative has tendered his resignation? We consider we were quite justified in our "note" on the subject to which our correspondent alludes. In conclusion we may add that we still hold the most favourable opinions as to the merits of the Pilsen-Joel Company's system, and we shall be very pleased to make public any refutation of what we have written if Mr. Joel can show where we have been mistaken.—EDS. ELEC. REV.]

ELECTRIC LIGHT TENDERS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I feel extremely reluctant to trespass upon your valuable space on a personal matter, but as Mr. James Beattie calls my veracity into question in your last issue, I feel certain that you will do me the kindness to publish my reply.

Mr. Beattie intimates that I publicly made a false statement, knowing the same to be untrue, and it pains me to know that there is a gentleman engaged in the same electrical work as myself who thinks me capable of such a dishonourable course.

Those of your subscribers who read his letter will be interested to know that I emphatically repeat "that the one tender sent in to the Camberwell Vestry was that sent by the Metropolitan Brush Company." Of course I refer to the most recent invitation of the Vestry for electric light tenders on the revised specification as recommended by the committee. Of this invitation Mr. Beattie seems to have been ignorant, and to have left us in possession of the field, though on the first invitation I find that the two tenders sent in were from the Pilsen-Joel and Metropolitan Brush Companies respectively, but a glance at the minutes of the Camberwell Vestry meeting will show Mr. Beattie that "*the one tender*" referred to by Mr. Price at the Metropolitan meeting, in the discussion and in the public [illegible]s, was the one from the Metropolitan Brush Company. [illegible] two earlier tenders, one from us and one it appears [illegible] the Pilsen Company, were treated as entirely out of

Yours faithfully,
R. HAMMOND.

[illegible]non Street, *August 30th*, 1882.

IMPROVEMENTS IN ACCUMULATORS.

[IN our issue of July 29th we took exception to the methods adopted by M. Blanchart in obtaining the results of his tests on electrical accumulators. On the 19th ult. we published a long and interesting letter from that gentleman, to which we now take the opportunity of replying.

To evade a question is not to solve it. It is not a matter of ascertaining whether the capacity of accumulators of equal weight may be increased. No one doubts that. Our *critiques* published in the ELECTRICAL REVIEW of the 29th of July, page 71, only aimed at the method of calculation adopted by M. C. Blanchart, and the facility with which one obtains surprising figures when the art of using them skilfully is acquired. M. Blanchart's letter answers absolutely nothing to these *critiques*. He does not dispute, in fact, that his calculations relative to kilogrammes of *active matter* only take into account the weight of the oxidised plate, and ignore altogether that of the reduced plate, the liquid, and the receptacle. It is, indeed, a convenient mode of obtaining high figures, but it is impossible for us to accept it, for, we repeat, the reduced plate is also active matter, and the idea of ignoring its weight has never occurred until now to any experimentalist.

M. Blanchart protests on the ground that we make him *say* that the electromotive force is constant, which, according to him, is not true. We beg M. Blanchart's pardon, but he has plainly *said* it, and *written* it, adopting in his calculation the formula: $\text{Tr.} = \frac{\text{E I}}{g}$, and taking for E the constant value of 2·15 volts. Was M. Blanchart authorised by previous experiments to take the figure of 2·15 volts as a constant electromotive force? The rapid decrease of a discharge current shows that it is not so and, moreover, the experiments of MM. Joubert, Pothier, and Tresca, have shown a diminution of from 2·165 volts to 2·057 volts, whilst the intensity of the current fell from 16·37 to 11·49 ampères. MM. Gladstone and Tribe have demonstrated also that after thirty minutes of rest or discharge the electromotive force which, in a *freshly charged* battery, is from 2·21 to 2·31 volts, falls to 2 volts, and even to 1·92 volts after forty-five minutes. Are these experiments sufficient to authorise M. Blanchart to accept in his formula a *constant* electromotive force of 2·15 volts?

As to the figures given by M. G. Planté, M. Blanchart neglects to state—what is essential, nevertheless—that if the battery has an electromotive force of from 1·45 to 1·50 Bunsen immediately after the discharge, if this electromotive force be measured *two or three minutes after the interruption of the primary current* (*see* the "Recherches sur l'Electricité," by M. Gaston Planté, p. 75) it is not more than 1·17 Bunsen.

We hold besides, with M. Planté himself, that we cannot count upon an electromotive force higher than 2 volts when the battery is *discharging*.

In conclusion, we maintain absolutely in meaning as in word our *critiques* upon the very original mode of calculation adopted by M. Blanchart, being unable to accept the hypothesis of a *constant* electromotive force in the case of a gradually *decreasing* discharge, and a calculation which, in the attempt to bring forward high results, takes into account as *active matter* only the oxide of lead.—EDS. ELEC. REV.]

THE TELEPHONE.—The United Telephone Company have opened an exchange at Brighton, and active operations have begun. Arrangements for connecting that town with the metropolis, under the powers granted by the Post-office, are now being made.

From Aberdeen we learn that there has been during the past few weeks a great increase in the number of subscribers to the exchange of the National Telephone Company. The desirability of putting the various fire-engine stations in telephone communication with the exchange, is now under the consideration of the fire committee, and should they report favourably arrangements will probably be made for keeping the exchange open always.

From Dundee we receive equally gratifying reports: the Dundee and District Company, and the National Telephone Company, are said to be working hard and adding many subscribers to their exchanges.

NOTES.

EXTENSION OF ELECTRIC RAILWAYS. — A *Post* telegram from Berlin, dated 22nd August, says :—"There is a great increase in the construction of electric railways throughout Germany, their success being established."

THE STEAMSHIP "INTERNATIONAL."—The s.s. *International,* belonging to the India-Rubber, Gutta-Percha, and Telegraph Works Company, returned on Sunday morning, the 27th ult., from Mexico and the West Indies, where she has been engaged in the extension of the Tampico-Brazos Santiago cable to Galveston and afterwards in the repairs of one of the International Ocean Telegraph Company's cables from Key West to Habana.

Both these undertakings were successfully carried out by Mr. Theophilus Smith, engineer-in-charge, assisted by Mr. H. Benest, Mr. J. Rymer Jones, Captain W. F. Wardroper, and others. The repairs of the Key West-Habana cable, however, were effected under the supervision and direction of Mr. M. L. Hellings, cable manager at Key West.

When the *International* has discharged her ballast and docked, she will receive the cable which is now being made at the Silvertown Telegraph Works for the French Government, to be laid along the coast of Tunis, from Soussa to Sphax and from Sphax to Gabes.

THE KEY WEST-HABANA CABLE.—We understand that the Key West-Habana cable of the International Ocean Telegraph Company of New York, which was repaired on July 15th last, had broken down again on the 22nd ult., and that the s.s. *Duchess of Marlborough,* one of the repairing vessels of the West India and Panama Telegraph Company, has been chartered for the purpose.

THE FRENCH ATLANTIC CABLE.—The *Times* says, "On the morning of the 29th ult. the Telegraph Construction and Maintenance Company's steamer *Scotia,* engaged in repairing the French Atlantic cable, put back into Plymouth from the Atlantic the second time in two months. When in May last the *Scotia* left London she had on board some 4,000 tons of cable stored in her immense fore and aft tanks. About 1,000 miles from Brest the cable was connected, and the vessel returned to within 400 miles of Brest to make good "a fault." Upon this work being taken in hand it was found that the American end of the cable was again broken, and testing demonstrated that the accident had occurred 20 miles east of the original breakdown. Buoying the cable, the *Scotia* came on to Plymouth, shipped coals and provisions, and left. The cable off Brest was spliced, and the *Scotia* sought the new fault. This was discovered, but considerable trouble was experienced in the endeavours to repair it. The cable was several times chafed at the bottom and parted, with the result that, after a month's work, affairs remain practically as before. One end is now buoyed ; the other is at the bed of the sea. During the operations 140 miles of cable have been paid out."

FURTHER EXTENSION OF THE NETWORK OF FRENCH CABLES ALONG THE NORTH COAST OF AFRICA.—In our number of the 5th ult. we stated that the India-Rubber, Gutta-Percha, and Telegraph Works Company had contracted with the French Government for the making and laying of 260 nautical miles of submarine cables to connect Soussa with Sphax and Sphax with Gabes. We are now informed that the same company has received a further order for cables to be laid from Gabes to a point on the west coast of the island of Djerba.

The making, &c., of these cables is superintended at the Silvertown Works, on behalf of the French Government, by Messrs. Rambaud and Schaeffer, engineers in the French Telegraph Administration.

Djerba, or Jerbah, is a large level island lying S. by W. ½ W., forty-three miles from Gzira, the western island of the Kerkenah group ; it is about nineteen miles in length east and west, and eighteen north and south, irregular in outline, especially on the southern side, and comprising a coast-line of about eighty-five miles in circumference.

The island is very fertile, with thick plantations of date and olive trees ; upon the coast are several forts ; villages and neat-looking white cottages are scattered over the country. There is a considerable trade in oil, wool, and fruit. Shawls, &c., are manufactured and exported, and there is also a large pottery. The island still produces the lotus, from which it derived one of its ancient names "Lotophaji."

The principal town is Zoug, which has a castle and the singular pyramid of skulls commemorating the defeat by the Turks of some Spanish soldiers under the famous Andrea Doria.

THE ELECTRIC LIGHT.—At the annual three days floral *fête,* which opened in Dundee on Thursday last, the Northern Light Company exhibit one of their systems of electric lighting. At a meeting of the Aberdeen Market Company, held on Friday week, to sign the contract for the restoration of the building which was recently destroyed by fire, it was intimated that the propriety of lighting the new building by electricity was engaging the attention of the directors.

The Highland Railway Company are at present considering proposals from several electric appliance companies to light the Inverness Station, the Station Hotel, the offices, and the company's works by electricity. At a meeting convened by the Ratepayers' Association of Gainsborough, to approve or disapprove of the adoption of the electric light as a street illuminant by the Board of Health, a resolution, "That this meeting, having had an opportunity of judging the capabilities of the electric light and contrasting it with gas, urgently recommend the Local Board of Health to adopt the electric light for lighting the town, if the cost compares favourably with the price paid for gas," was carried *nem. con.* amid loud applause.

On Saturday evening last, the additional lamps, which have been fitted up at the Waverley Railway Station, Edinburgh, were brought into use. So far the light has given the greatest satisfaction and compares advantageously with the experiments conducted twelve months ago on Princes Street. We believe that an application is about to be made to the Town Council for permission to make another series of experiments with the light on the streets.

THE ELECTRIC LIGHT AT COLCHESTER.—Information has reached us that the S. E. Brush Electric Light Company has established a station at Colchester. Owing, however, to some alteration in the driving apparatus being necessary some delay has occurred in bringing the electric light into use at Messrs. E. S. Sanders and Son's establishment, but it is confidently expected to be in operation before the end of the present week. The station is for the supply of the Brush system, and several of the leading firms in the town have expressed their readiness to adopt the electric light as soon as the station is in working order.

THE ELECTRIC LIGHT FOR SNARING FISH.—In our issue of July 15th we published a letter from "DEN[illegible]" suggesting the use of the electric light for attracting fish towards the nets. From France we now learn that [illegible] in the hands of some ingenious Frenchmen, who have lately, by permission of their Government, been experimenting with it, the results obtained have been highly satisfactory. The lamp was contained in an air-tight globe, and was lowered at night into the sea, with the result that thousands of fish of all sizes were attracted to its brilliant light. Boats furnished with nets gradually closed in upon the living mass and made a great haul of fish.

THE JABLOCHKOFF ELECTRIC LIGHT.—Messrs. Shoolbred and Co., of Tottenham Court Road, have now forty lamps in use in their various departments. We understand that Messrs. Shoolbred are satisfied with the financial results.

THE ELECTRIC LIGHTING IN THE BIRMINGHAM TOWN HALL.—Swan incandescent lamps are employed to the number of 496, the electric current being furnished by Bürgin dynamo machines, stationed at the Cambridge Street Works, and connected with the hall by cables laid under-

ground. The greater number of the lamps are arranged on pendant brackets attached to the pilasters which form the leading feature of the structural decoration of the hall, and there are also fifty-two lamps placed in pairs underneath the galleries. These brackets, which are of brass, have a bold, curving sweep outwards and downwards, and then divide into twelve branches. To each branch is attached a small Swan lamp. Along each side of the hall are eight of these brackets, each bearing a cluster of twelve lamps. Over the orchestra there are six double brackets, carrying twenty-four lamps each, while four similar brackets overhang the great gallery. The light thus provided is estimated to be equal to 8,000 candles, as compared with 5,600, which is the power of the ordinary gas illumination of the hall. An engine of 120 horse-power is employed for driving the dynamo-electric machines, there being twelve "Bürgins" of the C type, three being used as excitors for the remainder. We understand that the copper conductor of the cables was manufactured by Messrs. Winfield & Co., of the Cambridge Street Works, and the covering was done by Messrs. Glover, of Manchester. We believe hopes are expressed that the installation may be for a permanency.

THE TELEPHONE IN THE DIVING BELL.—On the suggestion of Mr. H. H. Wake, the engineer to the River Wear Commissioners, says the *Newcastle Chronicle*, the telephone has been applied as a means of signalling between the workmen in the Commissioners' diving bell and the workmen in charge of the crane and air-pump for governing the bell, in the craft employed for submarine work. On Saturday last Mr. A. W. Heaviside, the superintending engineer of the Post-office telegraph system, and Mr. H. H. Wake, made a successful trial at the entrance to the South Dock, Sunderland. The signalling between William Cooper in charge of the diving bell at the bottom of the river and James Miller in charge of the machinery in the craft at the surface was all that could be desired. In fact, everything that proceeds within the bell can be heard above, every stroke of the hammer or whisper of the men. So far as is known, this is the first occasion on which the telephone has been applied to so useful a purpose. It is worthy of remark that in this application of the telephone, which will be exhibited at the forthcoming North-East Coast Marine Exhibition, to be held at the Tynemouth Aquarium, the workmen in the bell have no necessity to speak into the telephone whatever. So long as the telephone is within the bell it records all that is passing."

This is, as our readers are aware, not the first occasion on which the telephone has been applied to the diving bell. In March, 1880 (vide ELECTRICAL REVIEW, Vol. viii., page 125), an experiment similar to the above was made at the Earl Grey Dock, Dundee.

WAR AND SCIENCE.—The Oriental Telephone Company have received from their representative at Alexandria an extract from an official letter to the Admiralty from Admiral Sir Beauchamp Seymour, who writes as follows:—"The telephonic communication which I reported in my previous letter had been established between the *Helicon* and the British Consulate has proved of the utmost value to me since the outbreak of this *émeute*, and inspired the English residents with a certain amount of confidence, as by its means I have been kept constantly aware of the state of affairs generally. In default of this ready means of communication it would have been impossible for some hours to have gained any information from the town except by special messengers, at imminent risk of life."

AN UNPRODUCTIVE TELEGRAPH OFFICE.—Fully twelve months ago, a Postal Telegraph Office was opened at the town of Keiss (Caithness), under a guarantee of £49. We understand that the receipts for telegraph business for the year amounted to the small sum of £24 9s., and consequently the two guarantors have received invitations to jointly contribute £24 11s., that the revenue may sustain no loss.

THE INTERNATIONAL METEOROLOGICAL COMMITTEE.—At he second meeting of this committee, recently held at openhagen, it was resolved to organise an exhibition in connection with the International Fisheries Exhibition, London, of the methods and apparatus used in different countries for giving weather intelligence and storm warnings to the coasts, and of the instruments, &c., used in the study of ocean meteorology. Several resolutions were passed with a view of obtaining greater punctuality and accuracy in the scientific information furnished to the committee. M. Tietjens, chairman of the Great Northern Telegraph Company, submitted a plan for a cable to connect Iceland and the Faroes with Europe, the expense to be met by the receipts from Meteorological telegrams. The committee, while recognising the very great importance which information got from Iceland and the Faroes must possess in relation to the issue of storm warnings and forecasts in Europe, felt they were not in a position to express an opinion on the practical execution of the project.

ON THE THEORY OF THE VOLTAIC BATTERY.—By G. Cantoni.—The author observes, in the first place, that the proposition of the co-existence of several movements can be used as the foundation of the reciprocal magnetic and electric inductions. He remarks, however, that if we regard bodies as composed of bipolar elements, each of which exerts two equal and opposite inductions, and if we contemplate a series of n such elements, the action upon the poles of each element of the series will be derived from the joint action of the poles, and of that induced by the homologous poles of the other elements. If m expresses the order of an element, p, of the series, the sum of the internal inducing actions of its poles will be $m + n - (m - 1)$; where the effects, m, have an opposite sign to those, $n - (m - 1)$; further, if p' is the element as far remote from the central position as p, the sum of the internal inducing actions of its poles will also be $m + n - (m - 1)$, where likewise the actions, m, are of opposite signs from $n - (m - 1)$. For the element, p', the effects, n, and $n - (m - 1)$, are of opposite signs to the effects, m, and $m - (m - 1)$, of the element, p. The algebraic sum of the inductive actions of each pair of elements, equidistant from the middle point of the series is, therefore, $= 0$; the action of the n elements of the series is also null; and that of the central element, or the central pair of elements, is null; whence follows the neutral line of the system. Since further, $m + n - (m - 1) = n + 1$, and is, therefore, independent of m, the sum of the inducing effects is constant for each element of the series.

If we approach to one pole, b, of an insulated electric element, a, b, an inducing ball, a', connected with the ground at a very small distance, and in a perfectly insulating medium, the end, a, of the ball displays, in consequence of the induced action of b, an equal and opposite inducing action upon b, so that the outward action of the other pole, a, is doubled. This corresponds to the impulse experiments performed with a series of balls of equal mass suspended in succession. Quite analogous is the composition of the inducing actions in coated insulators.

The author further compares such an insulator with a battery, and remarks, that if in the former the two poles are several times connected by a conductor, we obtain a series of discharges of decreasing intensity; whilst in a battery all the sparks are equally strong, since the heat evolved in the battery by chemical activity affords a constant source of energy. The succession of sparks represents the current.

Further observations refer to the fact that the current does not increase infinitely in a battery.

The author further discusses the thermic, chemical, and electrical phenomena which appear in a voltaic battery, amidst the reciprocal action of heterogeneous solids and liquids, whereby the intimate relations between the quantities of heat contained in the bodies, their combining weights and combination heat, but which do not appear in the open battery.

The author finally remarks, that Ohm's formula treats of the cause of the production of the electromotive force, whilst Faraday's and Joule's laws present equivalences between the values which appear in the current. He therefore considers the latter more essential than the former.—*Wiedemann's Beiblätter.*

ON THE ELECTRICITY OF FLAME.—By Julius Elster and Hans Geitel.—Concerning thé electricity of flame there

exists a great mass of researches which contradict each other in several respects, both as to the results and as to the views put forward by different authors on the cause of the electricity of flame. The origin of the electric difference may find its explanation in the following three causes:—The electricity of flame is determined by the combustion process as such (Pouillet, Hankel). It is caused by the flame behaving as an electrolyte to the metals introduced as electrodes (Matteucci). It depends on a thermo-electric difference of the electrodes.

The authors have come to the following experimental results:—

1. The longitudinal polarisation of the flame is only apparent, and is elicited by the unequal introduction of the wires which serve as electrodes.

2. The flame evinces in its transverse section a strong electric polarisation, and the electrode which is plunged into the stratum of air immediately enveloping the flame is always positive towards the electrode which enters the flame itself.

3. The electromotive force does not depend on the size of the flame.

4. The change of polarity of the flame may be produced by a suitable displacement of the electrodes.

5. The electromotive force of the flame depends on the nature of the metals employed as electrodes and on the nature of the gases consumed. It is especially strong if aluminium or magnesium is used as a conductive metal, and especially weak if the electrode in the air is coated with salts, *e.g.* chloride of potassium.

6. By employing electrodes of water and excluding all metals indubitable electric effects of flame may be also obtained, the electrode in the air being always positive to that in the flame.

7. Flames may be combined after the manner of galvanic elements, thus forming a "flame-battery."

The magnitude and kind of the electric excitement are independent of the size of the flame, but depend on the nature and the superficial condition of the electrodes, on the nature of the burning gases, and on the state of ignition of the electrodes. The authors infer that Hankel's theory is not in harmony with the facts, whilst the kinds of excitation assumed by Buff and Matteucci may be regarded as simultaneously determining the apparent electricity of flame.—*Annalen der Physik und Chemie.*

On the Action of Tension upon the Electric Resistance of Copper and Brass Wires.—The wires were stretched in a tin-plate cylinder, filled with water, 913 mm. in height and 192 mm. in diameter. The displacement of the marks on altering the tension could be observed through box-shaped expansions, closed with glass plates. The corresponding changes of resistance were measured by means of Jacobi's rheostats. The most careful observation was made on three brass wires taken from the same original piece, and drawn successively thinner and thinner. The wire contained 63·66 per cent. of copper, the rest being almost exclusively zinc. In order to find the change of the specific resistance, the co-efficient of elasticity, E, and the co-efficient of torsion, C, were determined in kilos., and thus $\mu = (E/2\ C)\ 4 - 1$ was calculated. If σ is the experimentally determined proportion of the relative change of resistance to the relative change of length, $\sigma' = \sigma - (1 + 2\ \mu)$ represents the proportion of the change of the relative specific resistance to the relative change of length. In the three wires, with the respective thickness of 0·91, 0·79, 0·46 mm., the co-efficients of elasticity and torsion of which became successively smaller, and the absolute electric resistance became greater, the ratio σ'' of the change of relative specific resistance to the relative change of length, increased from 0·298 to 0·316 and 0·415. The mean value of $\sigma'' = 0·342$.—*Mél. Phys. de St-Pétersbourg.*

On Systems of Electric Recipients consisting of Chains.—By A. Jedlik.—Barometer tubes closed at one end before the lamp, 66 c.m. in length and 10 to 12 in diameter, are filled to the height of 30 c.m. with fine iron filings, coated without with tin-foil opposite the filings, and the free service covered with shellac varnish. A copper wire plunging into the filings leads outwards. Several tubes are set in a glass cylinder, which is closed above and below, with hollow brass globes or tin capsules, the one in contact with the copper wires and the other with the tin-foil coatings. In this manner they are connected as a battery. The surface of this battery is relatively large; there is no fear of an over-stroke over the broad uncoated margin, and it takes up little room.

A number of such tube batteries may be placed together horizontally or perpendicularly upon insulating feet, and may be connected either laterally or in succession. A Lane's jar, connected with the coating, which discharges itself at a certain charge of the battery, prevents the perforation of the glass tubes.

With a cascade-battery of four such elements the striking distance, under favourable conditions, is 30 to 40 c.m., and is nearly proportionate to the number of the elements. Between two wires, cemented into a glass tube with sealing-wax, the spark travelled along the surface of the tube for 90 c.m., whilst its striking distance in the air, in the latter case, was only 18 c.m.—*Wiedemann's Beiblätter.*

Improvements in Electric Batteries.—Conical vessels containing the funnel-shaped electrodes, and each having below a supporting block, are inserted in each other. If the elements are to contain two liquids they are separated by funnels of felt. For secondary batteries the vessels are formed of lead, their two surfaces serving respectively as positive and negative electrodes.—*Wiedemann's Beiblätter.*

Geissler's Tubes with Vapours.—By K. Krajewitsch.—The same series of luminous phenomena which is observed in Geissler's tubes, by increasing rarefication of the air is perceived; also if the tube is filled with saturated watery vapour, and is then gradually cooled more and more in a freezing mixture. If mercurial vapour is used instead of watery vapour, the tube gives no discharge at common temperatures, but if it is heated stratification appears.—*Jour. Russ. Phys. Chem. Gesell.*

NEW PATENTS—1882.

4036. "Apparatus for winding coils of wire upon the armatures of dynamo-electrical machines, and for like purposes." W. [illegible] Espeut. Dated August 23.

4044. "Telephone receiving apparatus." R. and M. Theiler. Dated August 23.

4045. "Warning or signalling apparatus, for the protection of property and other purposes." A. Gluck and H. Diggins. Dated August 23.

4046. "Electric arc lamps, and mechanism for electric lighting." J. D. K. Mackenzie. Dated August 23.

4049. "Commutator for dynamo or magneto-electric machines." H. R. Lewis and W. C. Smythe. Dated August 23.

4065. "Electric lamps." C. S. Snell. Dated August 24.

4073. "Electric bell and automatic alarm apparatus, and [illegible] applications thereof. P. M. Justice. (Communicated by V. Vankeerberghen.) Dated August 25.

4079. "Secondary batteries for the accumulation of electricity and mode of constructing the same." L. H. M. Somzée. Dated August 25.

4080. "Electric measuring, recording, and regulating apparatus." S. H. Emmens. Dated August 25.

4084. "Arc electric lamps." P. R. Allen. Dated August [illegible]

4087. "Lighting of railway trains by electricity and apparatus [illegible] be used therefor." H. E. Newton. (Communicated by S[illegible] Universelle d'Electricité Tommasi.) Dated August 26.

4110. "Telephonic apparatus." G. L. Anders. Dated August 28.

4111. "Dynamo-electric machines." H. H. L[illegible]. (Communicated by S. F. Van Choate.) Dated August 28.

4127. "Electric controller and indicator for [illegible] clocks and [illegible] purposes." J. Wright. Dated August 29.

4147. "Galvanic batteries." S. H. Emme[illegible]. Dated August [illegible]

4148. "Generating, intensifying, and ac[illegible] electrical energy." P. de Villiers. Dated August [illegible]

4149. "Hanging electric and other lamps, [illegible] and other articles, and for removing them from their place of suspension." A. M. Clark. (Communicated by H. G. Fiske.) Dated Augu[illegible]

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1881.

5688. "Cymaphens or apparatus for transmitting sound by electricity." C. F. VARLEY and F. H. VARLEY. Dated December 27. 10d. The first part of the invention may be described as a diaphragm microphone. Fig. 1 represents one arrangement of this invention. On the end of the style, E, there is an adjusting nut for regulating the pressure spring, *b*, which is made to press the cross bar, *a*, against the contact pieces, *c*, c^1. To cross bar, *a*, an armature, *f*, made of

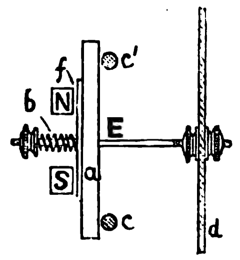


FIG. 1.

iron or other suitable magnetic metal is attached. Near to this armature the poles, N and S, of an adjustible magnet are placed; these poles attract the armature and counteract the force of the spring, *b*. It is obvious that if the magnet is of sufficient force, it would overcome the pressure of the spring, *b*, and open the circuit between *c* and c^1—if the space between armature, *f*, and the poles, N and S, be increased the magnetic force is weakened, and the spring, *b*, forces the cross bar, *a*, into contact with *c* and c^1,—thus by regulating the distance of the magnet *n. s.* and the force of the spring, *b*, any degree of contact pressure can be produced, and the most sensitive condition for transmitting sound by means of electric waves obtained. Fig. 2 shows a simple method of producing the augmentation of the variation of the current. To the diaphragm, D, is attached an iron crook, C, making contact with C^1, which latter is adjustible. The current

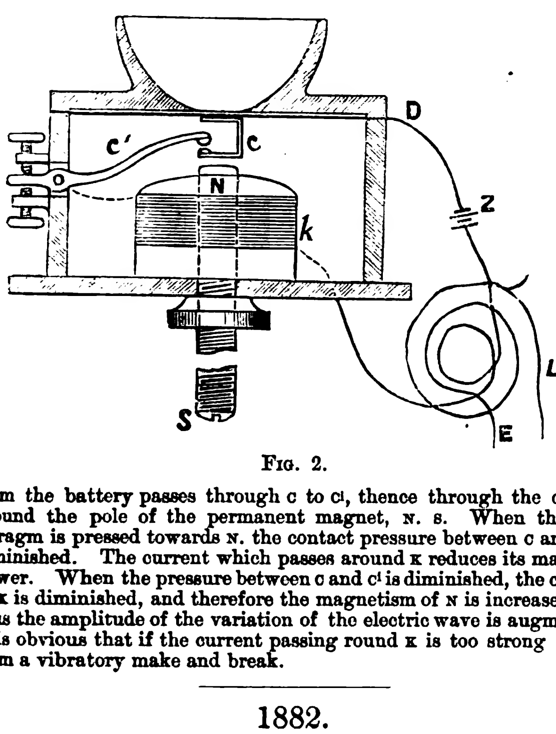


FIG. 2.

from the battery passes through C to C^1, thence through the coil, K, around the pole of the permanent magnet, N. S. When the diaphragm is pressed towards N. the contact pressure between C and C_1 is diminished. The current which passes around K reduces its magnetic power. When the pressure between C and C^1 is diminished, the current in K is diminished, and therefore the magnetism of N is increased, and thus the amplitude of the variation of the electric wave is augmented. It is obvious that if the current passing round K is too strong it will form a vibratory make and break.

1882.

130. "Machinery for obtaining, transmitting, and applying electric currents for lighting, &c." W. T. HENLEY. Dated January 10. 1s. 6d. Relates chiefly to dynamo machines similar in general construction to those described in the number of the Review for August 1st, 1881.

305. "Electric lamps." J. N. ARONSON. Dated January 21. 6d. An incandescence electric lamp, according to this invention, is constructed with a globe or translucent containing vessel having one or more reflectors formed in, on, or with the material of such globe or vessel itself. The reflective surface may be produced by silvering, painting, gilding, or enamelling the material of the globe or vessel either inside or out, or by shaping the globe or vessel so that it shall form one or more dioptric or cata-dioptric lenses or prisms.

346. "Electric lamps, &c." R. E. B. CROMPTON. Dated January 24. 8d. Relates to improvements in the inventor's well-known arc lamp.

358. "Sounding apparatus." C. A. MCEVOY. Dated January 24. 2d. The improved sounding apparatus operates by completing an electric circuit when it comes into contact with the bottom. (*Provisional only.*)

CITY NOTES.

OLD BROAD STREET.

THE GÜLCHER ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Wednesday morning the first ordinary general meeting of the shareholders of the above-named company was held at the Cannon Street Hotel under the presidency of Mr. John Blundell, chairman of the company.

The secretary, Mr. C. B. Charlewood, having read the notice convening the meeting,

The Chairman said: Gentlemen, this you are aware is called the statutory meeting of the company held, by the requirements of the Act of Parliament, four months after the registration of the company, which took place on May 1st. It is not usual at such a meeting to go into detail or formal business, but we have simply now to tell you how far we have progressed with this company. You are aware that the company only started in May, and therefore there has not yet been much time to do anything, but the secretary will read to you a report of the business done so far as it has gone. I can assure you everything is as satisfactory as it can be. This time of year is not the best for bringing out subsidiary companies, and we have, therefore, deferred putting forward several that we have in hand until November.

The secretary then read the following report:—

The company was incorporated on the 1st May last, and the first allotment of shares was made on the 10th of the same month. The total number of shares that have been applied for is 28,147, of which number 27,937 have been allotted to 307 shareholders, leaving a balance of 2,063 to be taken up before a quotation on the Stock Exchange can be obtained. On the 16th June an agreement was entered into with Mr. William Crookes, F.R.S., by which the company undertook to purchase his incandescent lamp upon very favourable terms. The directors congratulate the shareholders upon having acquired this light, as an incandescent lamp is indispensable for household lighting, and they consider Mr. Crookes's lamp by far the most perfect invented, both as regards durability and economy. The directors have also the pleasure to announce that Mr. Crookes has accepted a seat on the board, and they feel assured that the company cannot but derive great benefit from the services and advice of such an experienced and well-known electrician. The directors beg to announce that they have disposed of a concession for the sale of Gülcher dynamos and lamps in Scotland, and that they are negotiating for the sale of further concessions for districts and towns. The Gülcher light was exhibited at the fêtes of the Royal Horticultural and Botanic Societies, and was very much admired both for its brilliancy, steadiness, and softness; and H.R.H. the Duchess of Teck, on the occasion of the *fête* at the Botanical Gardens, sent for Mr. Gülcher and congratulated him upon the success of his light. Messrs. Ransome, Josselyn, and Woods, of Battersea Foundry, who are manufacturing dynamos and lamps for the Gülcher Company, have, of course, had great difficulties to contend with at first, as, with the exception of Mr. Gülcher and his foreman, the work was comparatively new to all; but the directors are happy now to be in a position to announce that these difficulties have been successfully overcome, and that dynamos are being manufactured at Battersea which Mr. Gülcher pronounces to be perfect in every respect. Lamps of various candle-power are also being manufactured. A special factory has been constructed at Battersea for the manufacture of Crookes's incandescent lamps, where they are now being made, and in a short time it is expected that they will be turned out at the rate of over one thousand per week. The directors are happy to say that they have numerous orders in hand for installations from various parts of the country, and that the plant for the execution of these orders will be delivered during the course of the next month. They are also negotiating with subscribers to hire the light from two large centres; the net income from one of which alone will be from £5,000 to £6,000 per annum, and the second centre referred to is likely to be on quite as large a scale. The directors have decided to send exhibits to the North East Coast Exhibition, to be held at Tynemouth, commencing on the 6th September; to the Crystal Palace Electrical Exhibition, commencing in October next, and also to the Royal Aquarium Electrical Exhibition, to be held during the coming winter. The directors have the pleasure of stating that arrangements have been come to between the company and one of the most influential firms in New Zealand to represent them there as their agents; and they expect shortly to conclude a similar arrangement with another eminent firm for representation in India. Both these agencies are likely to result in the formation of large branch companies in these colonies. The directors think that they may congratulate the shareholders upon the prospects for the future of the company being most promising, and they look forward to the shares of the company rising considerably in value at no far distant date.

The Chairman said: Having heard this report, gentlemen, I have very few words to say in addition to it. I am not aware that it is usual to move the adoption of such a report, it is issued for the benefit and for the information of the shareholders. The directors are quite confident that the company is likely to prove a successful one, but, of course, it requires time. You have all read the report of Dr. Siemens at Southampton, in which he says electric light is undoubtedly the light of the future. As regards the arc light for factories and the incandescent light for mines, there is no doubt that the electric light is the light of the future. We have every advantage. We have made the best terms possible with Messrs. Ransome, who are very large manufacturers; and by making terms with them we have been able to save an expenditure of capital, which has not been the case in other companies. Of course you are aware that making dynamos, which are new,

requires considerable time. Even during the last two months, Messrs. Ransome have turned out several very valuable machines. I think the Brush Company were some considerable period before they turned out any good machines; and therefore so far, I think, we may congratulate ourselves on being very successful. As regards Mr. Crookes' lamp, it is the best yet produced, and we have purchased it on very favourable terms. Mr. Wm. Crookes, who is one of the first electricians in the country, has become a member of our board; and no doubt his addition to the board is a very great acquisition, as he at all times is ready at hand to give us his valuable advice. It will be, of course, to our interest to keep down expenses and to carry on the company in the best way that we can. With regard to concessions, there is no doubt we should have been more successful were it not owing to the state of affairs in the East. There has been a scare in the money market; but the fact that one gentleman has put down £1,000 on deposit for the Scotch concession is a proof of its *bona fides*. Another concession has fallen through, and I think it is a good job that it has, for the terms were not the most favourable to this company. We have still that part of the country to deal with. I think, gentlemen, I have no further information to give you now. I hope next time we meet I shall be able to report most successfully of the company. The information we now give is given voluntarily, for the sake of the shareholders.

Mr. Briers asked whether the board had yet given consideration to secondary batteries.

The Chairman said they had under consideration a new secondary battery, said to be very successful and cheap. It was at Messrs. Ransome's works, Battersea, and was being tested now. Of course these things required very great consideration. Enormous prices were asked for these different patents. Several patents had been offered them by one person and another; but the one they were now testing they were told was the best, so that they would then have the best arc lamp, the best incandescent lamp, and, they hoped, the best accumulator. Mr. Gülcher was present, and he had much pleasure in introducing him to the shareholders. That gentleman had done his best to meet their requirements; they had engaged his services for a time in order that he might be able to help them to realise their wishes. They were really very much indebted to Mr. Gülcher for the interest he had thrown into the concern.

Mr. R. J. Gülcher remarked that he was convinced that his system of electric lighting was a good one. As he had done his best in the past, so he promised to do in the future. He hoped the meeting would excuse him from saying more, as he was an indifferent public speaker.

The Chairman said if any other gentleman had any further question to ask in connection with the company, he should have pleasure in answering him.

After a pause, and no further question being asked,

Mr. Cornell said, as no question was asked, he should be happy to move a vote of thanks to the Chairman, and also to the directors.

Mr. Briers seconded, and the motion was carried unanimously.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED.

On Thursday morning, under the presidency of Sir James Carmichael (Chairman of the company), the fiftieth ordinary half-yearly general meeting of the shareholders of the above undertaking was held at Cannon Street Hotel.

The notice convening the meeting having been read by the secretary, Mr. Edward Tombs,

The Chairman said: Gentlemen, the report and accounts have been distributed and circulated amongst you several days, will you take them as read? ("Take them as read.") Well, gentlemen, in moving the adoption of the report and accounts which have been submitted to you, I would merely draw your attention to the fact that the result of our working has been so far satisfactory as to show a slight increase in the traffic for the past half-year, and this notwithstanding the interruption for upwards of two months of the Corfu-Otranto cable. With regard to that interruption I may say that the repairs to the cable were conducted in the most satisfactory manner. We were, unfortunately, unable to obtain any steamer in the Mediterranean with proper apparatus for doing that kind of work, so we chartered one of Messrs. Headley & Co. She called at Malta and took on board the spare cable, and then proceeded to Otranto to repair the damage. The vessel was a little delayed by bad weather, but when she did begin the repairs only occupied twelve hours, and we only used one and a half miles of new cable. There is another satisfactory matter in connection with these repairs—that is the admirable state in which we found the cable close to where this accident occurred. That cable was laid in 1859, twenty-three years ago. And it reflects great credit on Messrs. Glass, Elliott & Co. that that cable should have come up so well after lying down so many years. This is particularly encouraging to us, because the other cable, from Malta to Sicily, was laid ten years later on—in 1869—and, of course, even so much the better must the one now be than the other. That is an encouraging fact to bring under your notice. You will remember that this time last year negotiations were entered into with another company for the purchase of this company's business, but those negotiations then fell through. They have been renewed again, but I am not at the present time in a position to lay any definite offer before you. What I should propose would be, if anything should come out of them which we think it is desirable to adopt—for the board to recommend to you—to call a special meeting for the purpose; it might be later on in the autumn. With regard to the death of our lamented friend, Mr. [Gur]ney, who has been connected with this company as director since [e]arly formation, I am sure you will with myself and others feel [muc]h sympathy. I have now to propose the adoption of the report [and] accounts.

Mr. Attwell seconded the motion.

Mr. Crafter: Do we understand that before you conclude any definite arrangement with the new company to take over these lines you will call a meeting of our shareholders?

The Chairman: Most decidedly. We have no power to do that without consulting the shareholders.

Mr. J. Hengler (Liverpool): When does the Government subsidy expire?

The Chairman: In December next, at the end of the present year.

A Shareholder: Then really there will be no more dividends?

Mr. Crafter: You will go on working with the £12,000 reserve fund?

Another Shareholder: You have no dilapidated cables now?

The Chairman: No.

Mr. Vears thought the company could make hay while the sun shines. He came in to the meeting rather late, and, although he did not want to be troublesome, he should like to ask if the chairman would be so kind as to go out of his course and tell the meeting whether anything likely to be substantial would probably come out of the negotiations going on? Was there anything upon which the shareholders might base their hopes in this matter? The simple negation, "We cannot tell you anything" led one to ask, "What can you tell us? Tell us whatever of good you can."

The Chairman replied that of course Mr. Vears was aware that in business matters it was sometimes very injurious and damaging in stating anything until a definite arrangement had been arrived at. He did not think he could go any further than he had.

Mr. Crafter: The negotiations are still going on?

The Chairman: Yes, sir; they are not stopped.

A Shareholder: Suppose these negotiations fall through, what will be our position then?

The Chairman: You will have to depend upon the earnings of the company.

Mr. Vears remarked that he did not like the idea of no dividend at all. If they could not pay their present dividend he thought perhaps they might be able to pay 1½ on the company's earnings.

A Shareholder: What is the subvention from the Government?

The Chairman: The total subvention from the Government was £2,700 a year; the half of that sum has been the average we have received from them since the starting of the company. We have not had occasion to ask the Government for all of it. We have taken the whole of it, thus, on account of our repairs.

Mr. Crafter: Is this the last dividend we shall have?

The Chairman: The subvention does not expire till the end of the year.

A shareholder asked whether, as the £12,000 in hand was in Consols, and earning only 3 per cent., the board had power to invest that money in preference shares and so earn 8 per cent.?

The Chairman: We have no power to invest our £12,000 in preference shares.

Mr. Hedley said he should like to congratulate the shareholders on the satisfactory statement made by their chairman as to the duration of their cable. The one now repaired they were told had been down twenty-three years; and therefore he thought the old theory of the ten years' life of cables was exploded.

The Chairman: Yes; they are to be congratulated.

The Chairman then put the motion for the adoption of the report, which, having been seconded, was carried unanimously.

Mr. Beart then moved the re-election of the retiring directors—Sir James Carmichael, Bart., and the Hon. Ashley Ponsonby.

Mr. Vears seconded, and the motion was carried.

In reply to a question as to whether the board intended to fill the vacancy caused by Mr. Gurney's death,

The Chairman said they had not yet decided to do so; but when they did—perhaps at the next meeting—the nomination would be submitted to the shareholders.

A Shareholder thought three directors on the board was very few.

Mr. Crafter was of opinion that three could satisfactorily manage the concern.

A proposition for the re-election of Messrs. W. E. Allright and W. G. Hayward as auditors having been seconded, the motion was put and carried.

The Chairman: I have next to propose payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the company's preference stock, and at the rate of 3 per cent. per annum free of income-tax on its ordinary stock, payable on and after the 7th proximo. The proposition having been seconded, was carried unanimously; and, on the proposition of Mr. Field, a vote of thanks to the chairman concluded the business of the meeting.

SIR W. THOMSON'S RECORDERS FOR SUBMARINE CABLES.—We read in the *Operator* that the French Government is going to adopt Sir William Thomson's recorder as a means of correspondence on its cables between Marseilles and Algiers. These cables are at present worked by means of the mirror galvanometer. Six recording instruments are now in course of construction for the French Administration of Telegraphs at Mr. White's, of Glasgow, who is the only manufacturer of Sir William Thomson's recorders. It is expected that the instruments will be in full operation by the month of August next. A select party of operators are now undergoing a course of lectures and tuition in the use of the recorder in the rooms and under the supervision of Mr. Ternant, director of the Eastern Telegraph Company, at Marseilles. The latter company has employed the recording instrument from the commencement.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 250.

ELECTRIC LIGHTING ON A LARGE SCALE.

OUR readers are for the most part fully acquainted with the electric lighting operations of the Edison Company on the Holborn Viaduct, with the additional extension of the system to the General Post-office. This is the most complete and best appointed arrangement of incandescent electric lighting yet seen in this country, and satisfactorily proves that its adaptation on as extensive a scale as gas is chiefly a question of first cost. We notice in the *Standard* of last Wednesday that its correspondent telegraphs as follows :—

NEW YORK, TUESDAY NIGHT.

Mr. Edison's system of providing an incandescent electric light for domestic use in a given district has just been put to a practical test in this city. The district selected occupies an area of nearly a square mile. Only one source of supply is provided, and that furnishes the illuminating power for sixteen thousand lamps, the electric current passing through 18 miles of mains. The result is that the severest demands which the consumers have been able to make upon the new system have been satisfied.

The *New York Herald* is using in its business premises an isolated plant on the same principle; and the managers assure me that they are satisfied in respect to the commercial aspect of the question.

No new obstacle has presented itself to the success in practice of Mr. Edison's theory; and scientific men will be interested to know that this first practical experiment demonstrates the soundness of the inventor's application of the multiple arc system, pure and simple, as distinguished from the series system, or the combination of the arc and series systems.

Throughout the entire district lighted as described, each lamp was independent of all the others. On the inquiry before the Select Commission of the British House of Commons, Dr. Siemens said it was impossible to supply electricity for domestic lighting from one source over a greater area than a square quarter of a mile. Last night, although only five thousand lamps were lighted, they were distributed over the entire district of the square mile. In the district there are fifteen hundred consumers of gas, of whom eleven hundred have subscribed for the electric light.

In the *Scientific American*, of August 26th, is to be found an illustrated description of this great installation of the Edison system, which varies in some details from the above. Additions, however, have probably been made since our contemporary's article was written. The district includes, according to our American authority, 946 consumers, and the number of lamps operated in connection with this scheme amount to no less than 14,311. Amongst the many interesting items forming part of this extensive undertaking we will merely allude to several of the most important. The Babcock and Wilson boilers are four in number, and can supply 250 horse-power each, and the electric current is produced by six of Edison's largest dynamo-electric machines. Each machine weighs complete (engine, dynamo, and base) 62,000 lbs. The field magnets weigh 33,000 lbs., and the armature 9,800 lbs. The length of this latter is 61, and its diameter 27·8, inches. The height of the machine from floor to top of field magnets is [illegible] ft. 4 in. The nominal capacity of each dynamo-electric machine is the production of 1,200 lights of 16 candle-power each; but at their maximum it is stated they can each produce 50 per cent. in excess of this.

The current from all the machines is centred in two large copper bars with which the several street conductors are connected, and if from any cause it is supposed that one of the machines is not doing its work properly, it can be instantly disconnected from the rest by a huge switch which cuts it off from the main conductors. The presumably faulty machine is then joined up to 1,000 test lamps of 16 candle-power each, and if the current produced by the machine brings these lamps to brilliant incandescence, it is in usable condition. Of course if this desirable result is not attained the existing fault must be sought for by other means. The size of the conductors varies with the requirements, those in the street are equal to a copper rod of one-half inch in diameter, and the service conductors differ, some being equal to two, and others to ten, No. 10 wires. The street conductors are something over 14 miles in length. The field-magnets of the dynamos are placed in a shunt circuit derived from the main circuit, which includes a switch and a number of rheostat coils, one or more of which may be thrown into the shunt circuit, so as to add to the resistance of the shunt circuit from a small fraction of an ohm to seven and a half ohms, which is the greatest resistance necessary to control the current exciting the field-magnets, and thus control the current in the main circuit.

There is a set of resistance coils for each dynamo, each set being provided with a circular switch, operated by a horizontal shaft through sets of mitre gearing. An attendant is stationed at the wheel at the end of the horizontal shaft, and turns the switches one way or the other, according to the requirements. He is able to judge of the amount of current required by watching an indicator above the regulator. This indicator is provided with two lamps, one red and one blue, and with a device for throwing one or the other of them into the circuit, according as the current is strong or weak; and neither lamp is illuminated when the current is normal. When the blue lamp is lit more resistance is required in the shunt circuit to reduce the amount of current passing through the wires of the field magnets, consequently the attendant turns the switch, throwing in one coil after another until the blue lamp ceases to shine. When the red lamp shines, the switch must be turned in the opposite direction to increase the power of the field magnet and to strengthen the current in the main circuit.

We believe the *Standard* correspondent is in error concerning the remarks he ascribes to Dr. Siemens. He merely suggested that one-fourth of a square mile would be a proper or convenient area to work from a centre, and we need scarcely remind the author of the telegram from which we quote that Dr. Siemens knows as well as Mr. Edison exactly what electricity *can* be made to do.

We have said sufficient to show the vastness and importance of this enterprise which appears likely to be a perfect success, and it is to be hoped that when the results of the Holborn Viaduct experiments are known they may be of such a nature as to induce London to follow the example of New York. Success in America will doubtless have a lively and beneficial effect upon electric lighting industries in England, which are apparently depressed for the moment.

THE LEVETT-MÜLLER ELECTRIC LIGHTING SYSTEM AND MULTIPLE CIRCUIT DYNAMO.

[We extract from the *Scientific American* the following description of a system of electric lighting which we think new to our readers.]

THE dynamo, which is shown in perspective in fig. 1 and in transverse section in fig. 2, is capable of yielding a number of separate and distinct currents, which may be employed in widely different kinds of work. The dynamo shown in the illustration furnishes four separate circuits, with electric currents for as many different uses. One current is used for the arc light, another for incandescent lights, another for the transmission of power, another for 'plating. By simply duplicating some of the parts of chine, the number of different circuits supplied may finitely extended, and the currents may be used ngeably for the arc lights, incandescent lights, electric motors, electroplating, storage of electricity, ore separating, and in fact for any of the purposes to which electricity is applied. The production of a number of separate and distinct currents in one machine is a novel feature claimed by Mr. Müller, and one that is of great utility. For example, by using one of these machines a hotel may have arc lights in the halls, offices, and in front, while its parlours and private rooms may be supplied with incandescent lights, and power may be furnished for its various operations of the kitchen and laundry. Similarly, public and business buildings and private dwellings may be equipped, and steamers may be provided with arc lights for the decks and head lights, while the state rooms and cabins may be provided with the softer and mellower incandescent light.

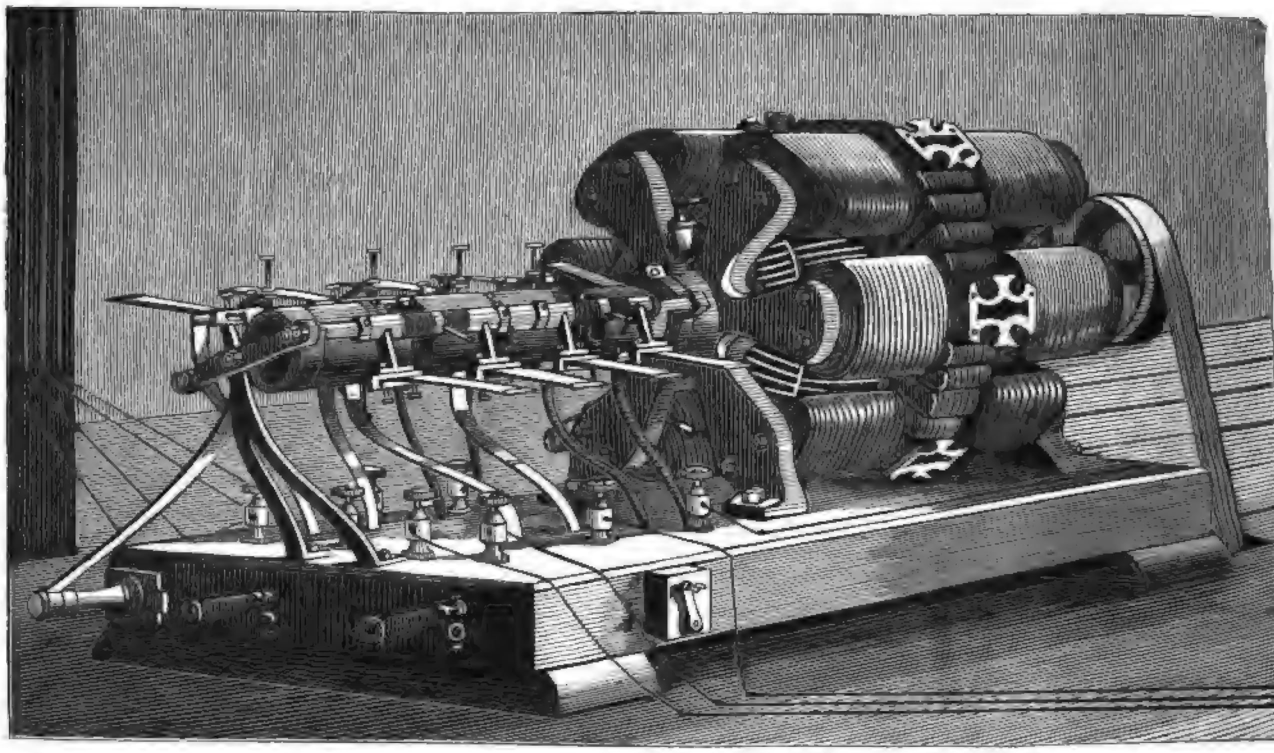


FIG. 1.

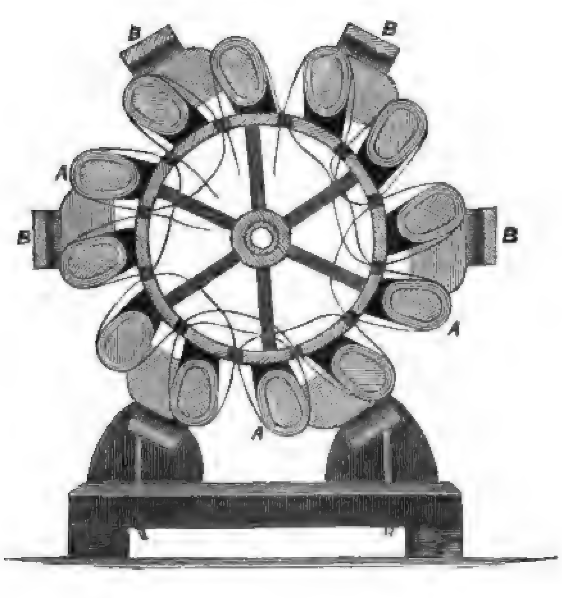


FIG. 2.

This desirable result is secured by employing a series of armature coils or bobbins, A, in an armature wheel rotating between the poles of two powerful multi-polar field magnets, B, the several bobbins being divided into series, each series being connected with a series of commutator bars, forming commutator cylinders, each being provided with a pair of collecting brushes, which deliver the current to the circuit upon which it is used.

To economise power the bobbins of the armature are arranged so that they are diagonal in relation to the poles of the field magnet. This plan allows the bobbins of the armatures to be removed from the vicinity poles of the field magnets with less force than would be required were the bobbins exactly radial.

The peculiar form of the armature wheel insures another important result—that is, the creation of a current of air throughout the machine, which keeps all of the parts cool.

The arrangement of the field magnets, armature bobbins, and connections is such that no bad effects are experienced from induction, the current in one circuit having absolutely no appreciable effect on that of another circuit.

This machine in ordinary working makes about seven or eight hundred revolutions a minute, and the lamps supplied by it seem to burn with absolute steadiness.

The arc lamp invented by Mr. Müller has a novel air check, which regulates the movement of the upper carbon. This, in connection with other new devices, renders the light very steady indeed. One form, which is shown partly in section in fig. 3, is of the same general construction as those burning single pairs of carbons, but made in duplicate, so at it will burn two, three, four, or more pairs of carbons in succession.

In this lamp, when the electric-arc is very small, there is very little resistance in the circuit, and the helix draws its core inward, raising the free end of the lever, A, as far as the upper screw will permit. This causes a pawl to engage with the ratchet-wheel of the feeding mechanism, which is rotated a short distance in the proper direction to raise the positive-carbon holder and lower the negative-carbon holder, thus separating the carbon points. This operation is repeated every time the carbons approach each other too much. The rapid descent of the carbons is prevented by

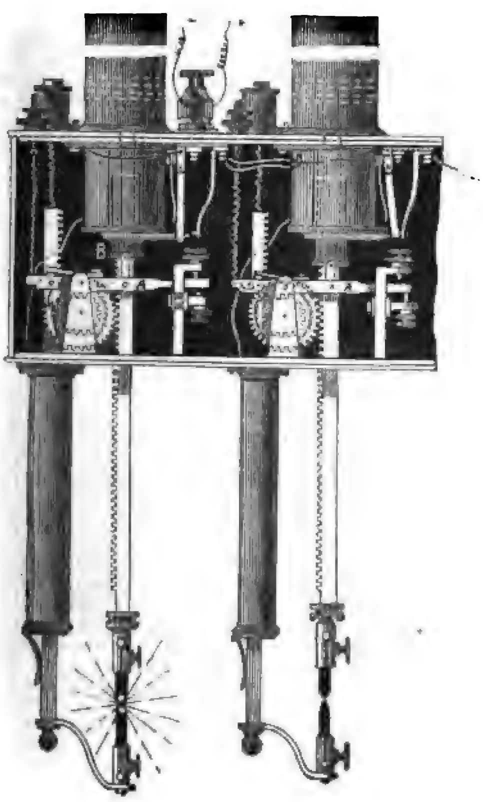


FIG. 3.

the piston attached to the upper or positive-carbon holder. The weight of the upper carbon and its holder, acting on the ratchet-wheel and its shaft, raises the lower carbon holder. As the positive carbon is consumed twice as rapidly as the negative carbon, the wheel which it moves must have twice the diameter of the wheel which moves the negative carbon. As long as there are any carbons in the first lamp, the current passes into the positive-carbon holder, the positive and negative carbons, the helix, the joint piece of the armature, and from there to the generator. During this time the armature at the side of the helix is attracted by the pole piece at the lower end of the helix. As soon as the first set of carbons is consumed to such an extent as to interrupt the circuit, the side armature is released from the pole-piece, and is pressed against a contact-strip which sends the current through the second set of carbons. As soon as the second set of carbons is consumed the armature of that lamp is released in the same way, sending the current to the third set, and so on.

It will be seen that by this ingenious arrangement the light may be made practically continuous.

Mr. Müller's incandescent lamp is shown partly in section in two views in fig. 4. In this lamp the inventor secures the following important results: first, replacing the carbon filament without breaking or rendering useless any part of the lamp; second, preventing the entrance of air through the joints between the plug and the conductors passing through it to the carbon filament.

The glass globe or bulb is provided with a flaring strengthened neck fitting very tightly on a bevelled glass stopper or plug, which is secured air-tight by means of packing material in a hollow base, D, adapted to be screwed on or otherwise attached to a bracket or chandelier arm. The glass plug and the neck of the globe are ground together, so as to fit air-tight against each other. A packing is placed around the plug and the edge of the neck as shown. Two carbon conductors of suitable thickness are passed through longitudinal openings in the glass plug projecting from the top and bottom of the plug, and secured in the plug by a suitable cement forming air-proof joints.

Copper rings are cast or blown into the top and bottom of the plug around the apertures through which the carbon conductors pass, and these rings project slightly from the ends of the plug. Copper is then precipitated by means of electricity around the projecting ends of the carbons and the rings. By this means the projecting ends of the carbons will be strengthened and prevented from being broken off, and the joint will be made air-tight.

The upper ends of the carbons are provided with slots into which the ends of a carbon filament are passed and secured by means of a peculiar cement. A glass seal tube

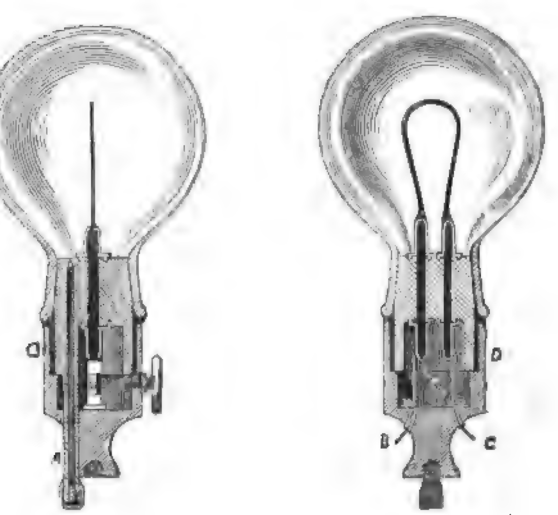


FIG. 4.

projects from the bottom of the plug through the base of the lamp, in which it is secured air-tight by means of cement. The end of this tube extends through the plug, and is contracted at its upper end. This tube is stopped at both ends, and the intervening space is filled with mercury.

Two insulated spring-contact strips project upward from the bottom of the recess in the lamp base, and rest against the lower projecting ends of the carbons. These strips are connected with conducting wires, B C, leading to the electric generator. A key journaled in the lamp base has at its inner end a crosspiece, which is of sufficient length to separate the strips and remove them from the ends of the carbons when it is in a horizontal position. When this crosspiece is in a vertical position the strips are released and rest against the ends of the carbons.

Should the carbon filament be destroyed or broken the globe is removed, a new filament is inserted, the globe is replaced, and the air is exhausted.

In addition to these interesting inventions, Mr. Müller has devised a very successful magnetic ore separator, and he has also perfected a storage battery for which great advantages are claimed.

LECTURES ON ELECTRIC LIGHT AND MOTIVE POWER.—Our readers probably noticed in the advertisement columns of our last issue that Mr. John C. Fell purposed delivering a course of eight elementary lectures on the above topic. These lectures commenced last Tuesday evening, and were continued on the following Thursday. The same course will be pursued during the next three weeks, the lectures being delivered in the Hall of the Society of Engineers, 6, Westminster Chambers. A syllabus of the course may be obtained of Fell and Wilding, 23, Rood Lane, E.C. Mr. Fell is well known to us as a science teacher, and his lectures are particularly well and clearly delivered. His long experience at the Birkbeck, and other literary and scientific institutions should enable him to give very concise and definite illustrations connected with his subject, and we can therefore safely assume that his young hearers will be materially benefited by what Mr. Fell has to say.

MEASURING INSTRUMENTS USED IN ELECTRIC LIGHTING AND TRANSMISSION OF POWER.

By Professors W. E. Ayrton, F.R.S., and John Perry, M.E.

[Read before the Society of Telegraph Engineers and of Electricians in May, 1882.]

During the last two years an enormous impetus has been given to the development of the electric light and electric transmission of power; and as accurate measurements form the basis of commercial success in this as in any other branch of engineering, we hope you may not find it too tedious listening to a short description of the details of certain instruments that we have devised and have had constructed for making accurately, and at the same time quickly, the measurements that are necessary to be made, in order that an estimate may be formed of the commercial success of any special system of electric lighting or transmission of power.

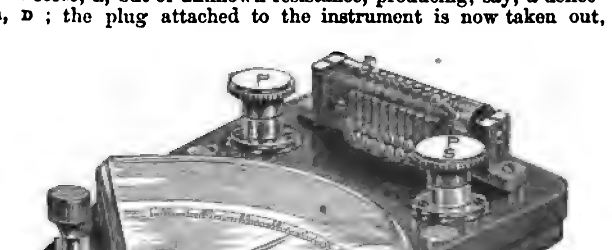
After the most charming paper given us at our last meeting, by Mr. Stroh, and of which the recollection must for a long time remain in all our minds, we feel that some apology is due to you for the rather prosy production which to-night follows it.

The chief objection to instruments used in measuring strong currents is that, first, the deflections are not proportional to the current, and, secondly, there is no easy method of calibrating the instrument—that is, ascertaining the strength of the current that is necessary to produce any given deflection. At the end of 1880, we tried in our "illuminator," used in connection with our apparatus for seeing by electricity, a method that has since been described by MM. Deprez and Carpentier, for making the deflection proportional to the current. This consisted in placing the axis of the coil, not, as is usual in galvanometers, at right angles to the axis of the permanent magnetic field, but at an acute angle with it, so that, instead of, as is usually the case in ordinary galvanometers, the magnetic moment due to the current diminishing as the needle is deflected, while that due to the permanent controlling field increases, and in consequence of which the current must increase much more rapidly than the deflection, our plan of sloping the coil causes the magnetic moment due to the currents to increase up to a certain point. But in our later instruments, indeed in all instruments with permanent magnetic fields that we have made since the commencement of 1881, we have abandoned this method in favour of giving to the coil, needle, and pole-pieces exactly the shape that theory shows to be necessary to obtain deflections exactly proportional to the current.

1. *Commutator Ammeter.*

Last year we had the honour of bringing before the society an instrument by means of which strong electric light currents can be measured, and yet which can be calibrated by the employment of a single Daniell's cell. This instrument, which we have since called an "ammeter," short for ampère-meter, contains, as the members will remember, a coil consisting of 10 strands, each of exactly the same resistance. These 10 strands, by means of a simple commutator, can be joined either in series or in parallel circuit, and so the sensibility of the instrument can be increased exactly 10 times without altering the dead-beat character of the instrument, which latter is produced by the extreme lightness of the needle and corrugated aluminium pointer and by the great strength of the magnetic field.

To calibrate the ammeter, the commutator is turned to series, and a current sent through the instrument by a cell of known electromotive force, E, but of unknown resistance, producing, say, a deflection, D; the plug attached to the instrument is now taken out,



Commutator Ammeter and Voltmeter.

which has the effect of adding a resistance of one ohm to the circuit, and a second deflection D_2 obtained. From this it can easily be shown that a current of 10 $\frac{D_1 - D_2}{D_1 \ D_2}$ E ampères will produce 10° deflection when the commutator is in series, or 1° deflection when the commutator is to parallel.

Many of the instruments are adjusted to give one ampère per degree when the commutator is to parallel; others, again, are arranged to give two ampères per degree; while some go as high as five ampères per degree, and therefore measure currents of over 200 ampères.

In designing this commutator ammeter, we originally only thought of using the high grade of sensibility for the purpose of calibrating the instrument, but we have found it extremely convenient when testing the comparatively small currents of 0·5 to two ampères used with incandescent lamps.

2. *Commutator Voltmeter.*

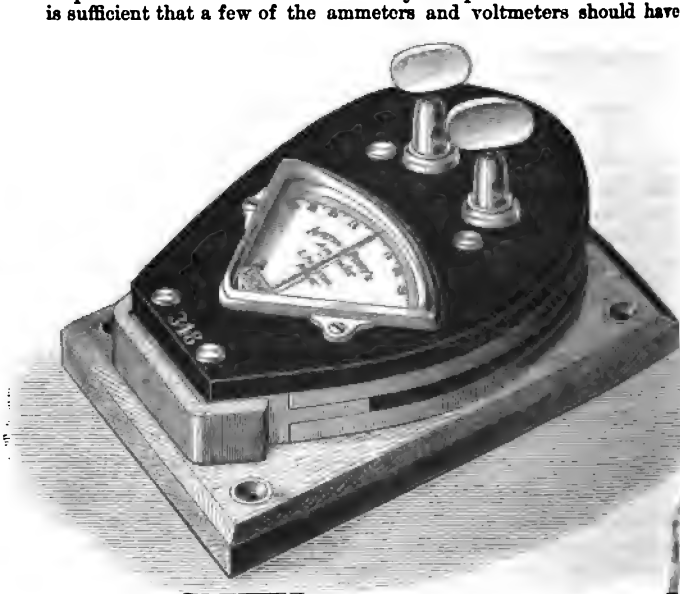
Since the reading of that paper, we have constructed a commutator voltmeter on much the same principle, but in this case each coil has a resistance of 40 ohms, so that when in series the instrument has 400 ohms resistance, and when parallel only four ohms, whereas in the ammeter the resistance in series is about 0·3 ohms and parallel 0·005, the latter being more than one-hundredth of the former, in consequence of the resistance of the small leading wires inside the instruments.* The ammeter is calibrated in series and generally used in parallel circuit, whereas the voltmeter is calibrated in parallel circuit and used generally in series, and indicates from one volt per degree in some instruments to five volts per degree in others, the total deflection of 45° in the latter case corresponding with 225 volts. But just as the ammeter can be conveniently used in series, when testing the comparatively small currents passing through a single incandescent lamp, so the voltmeter may be used in parallel circuit for testing electromotive forces of two or three volts, such as, for example, the electromotive forces of one or two Faure's accumulators. To calibrate the voltmeter, the commutator is turned to *parallel*, and a current sent through the instrument by a cell of known electromotive force, E, but of unknown resistance, producing, say, a deflection of D_1; the plug attached to the instrument is now taken out, which has the effect of adding a resistance of four ohms, and a second deflection, D_2, obtained. From this it can easily be proved that an electromotive force 10 $\frac{D_1 - D_2}{D_1 \ D_2}$ E volts between he terminals of the instrument will produce a deflection of 10° when the commutator is to parallel, or 1° when to series.

In the ammeter the resistance coil can be introduced in the circuit *only* when the commutator is to series, and in the voltmeter *only* when to parallel, so that in neither case can it be fused by the plug being accidentally taken or left out when a strong current, or, in the second case, a large electromotive force, is being measured. And more than this, to avoid the coils of the instrument itself being fused, or the needle being damaged by the instruments being arranged for maximum sensibility when currents or electromotive forces suitable for the 1-10th sensibility of the instrument are being measured, each instrument is provided with three binding screws marked respectively S (P S), and P, as seen in the figure. In all the newer ammeters the screw, P, is suitable for a thick wire, and S only for a thin, (P S) being suitable for either. Hence the wires from a dynamo, for example, can only be attached to (P S) and P, and not possibly to S. Now a current can only pass through the instrument from (P S) to (P) when the commutator is to parallel. Hence, if accidentally left to series, the circuit is merely interrupted, instead of the coils being fused or the pointer damaged by too large a deflection. Precautions of a similar kind are also taken in the construction of the voltmeter, by the use of three distinct binding screws on the instrument.

All the instruments are so wound that, when a current is sent from binding screw to binding screw, at each side of the commutator, the pointer points to that binding screw at which the positive current enters.

3. *Non-Commutator Ammeter and Voltmeter.*

In electric light factories or other places where many ammeters or voltmeters are employed, it is of course unnecessary that all should be provided with commutators for easy independent calibration. It is sufficient that a few of the ammeters and voltmeters should have



Non-Commutator Ammeter and Voltmeter.

commutators for independent calibration, the remainder, which in that case are made as shown in the following figure, being calibrated by direct comparison with the commutator ones.

In all our instruments the needle and pointer are pivoted [illegible]

* The voltmeters are now made with each coil having a resistance o[illegible] so that the instrument in series has a resistance of 2,000 ohms, an[illegible] circuit, 20 ohms, the resistance coil being also of 20 ohms.

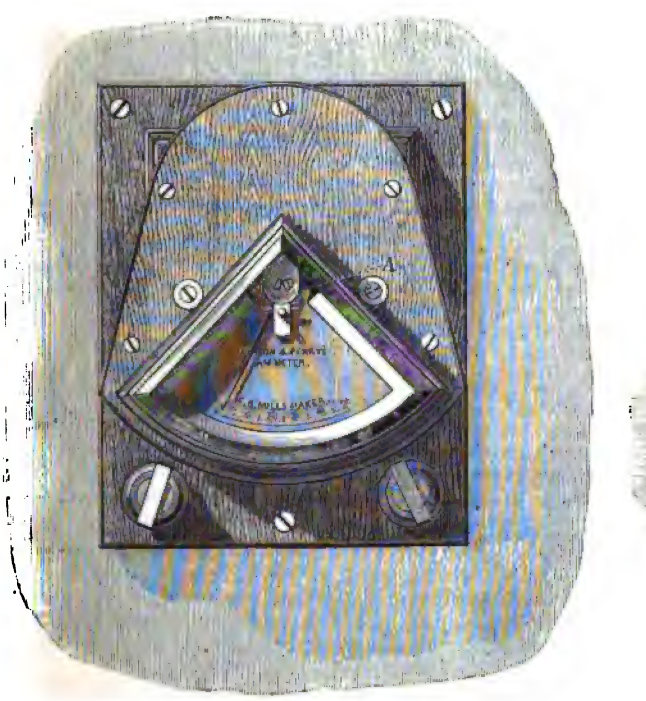
axis passing through their common centre of gravity, so that the deflexion is unaltered, no matter in what position the instrument be held, and the pivot resting in jewels top and bottom, the friction is also practically unaltered by turning the instrument on its side or holding it upright. The permanent attached magnet is also so strong, that the ammeters or voltmeters may be placed not very far from even a dynamo machine in action, without the magnetism of the machine affecting the indication of the instruments.

One difficulty, however, has practically arisen in the use of these instruments, and that is, although the special mode of winding adopted, combined with the existence of the commutator, enables any one by means of a single good Daniell's cell to calibrate his instrument for himself, practically Daniell cells do not exist at many places where there are electric light installations, and consequently people do not calibrate their instruments for themselves, and so do not detect the changes of magnetism in the permanent magnets which necessarily occur, and against which the user is warned by a notice stuck in the lid of the box accompanying every ammeter or voltmeter.

To partially avoid the loss of magnetism in the controlling permanent magnets, an armature, seen in the last figure, is supplied with each instrument, but which of course must be removed when the instrument is in use.

4. *Spring Ammeter and Voltmeter.*

To however completely overcome this difficulty of loss of magnetism in the permanent magnets, we have decided to abandon permanent controlling magnets, and so we have constructed ammeters and voltmeters like those shown in the following figure, and in which the controlling force is that of either a flat or a cylindrical spiral spring, A, the axis of the soft iron needle in this case making an angle less than a right angle with the axis of the coil when no current is



Spring Ammeter and Voltmeter.

passing, since if it made a right angle it would be in unstable equilibrium when a current passed. The best angle that the axis of the needle should make with the axis of the coil when the pointer points to nought, we have determined partly by calculation and partly by a long course of experiments, and we find that, with a proper initial adjustment, we can obtain deflections of the pointer up to 45° *directly proportional* to the current.

These instruments possess two important advantages not possessed by any of our earlier forms—the one being that they can be used with reverse currents; the second, that by giving any special set to the spring (for doing which there is a small hand, seen in the figure, and which can be turned through any angle indicated by a small graduated scale, A, under it), the needle does not start from the zero position until the current in the ammeter or electromotive force in the voltmeter exceeds a certain pre-arranged limit. This method of giving a set to the spring greatly increases the sensibility of the instrument. Suppose, for example, currents of about 30 ampères, or currents varying, say, from 25 to 35 ampères, are to be measured with a special instrument, then instead of the pointer starting from nought for even a small current, a set is given to the spring, so that the pointer does not leave the zero until a current of 25 ampères traverses the coils. In the former case, the spring would have to be so strong that the total possible deflection, 45 degrees, was produced by the 35 ampères—that is about 1·3° per ampère; whereas, in the latter case, a weaker spring set-up would be used, such as to be deflected through the 45° for an addition of 10 ampères to the 25 necessary to start the pointer. In the latter case, we should have 4° per ampère, or a sensibility about three times as great as before.

Spring voltmeters on a similar principle we have also had made.

5. *Wheel and Pinion Ammeter and Voltmeter.*

Where still greater delicacy is required, the form of the instrument is somewhat changed. Attached to the arbor of the needle is a wheel, W, with extremely finely-cut teeth gearing into those of a pinion, P, on the arbor to which the pointer is attached. With this arrangement the motion of the pointer is magnified ten times. If, then, the coil and needle have such a shape, and the axis of the needle makes such a proper initial angle with the axis of the coil that the deflection of the needle up to not more than even 36° is proportional to the current, then with our wheel and pinion arrangement the deflection of the pointer over the entire scale of 360° will be proportional to the current. In addition to these, both the arbor of the needle as well as the arbor of the pinion are provided with very delicate cylindrical spiral springs, S, S', one or both of which may be employed, since the latter can be thrown out of gear by raising the arm, A, which is done by turning the head; H, of the adjusting screw. If both the springs be of the same strength, then the sensibility of the instrument can be instantly made exactly one hundred times as great by turning the milled head, H, which raises the arm, A, and throws S' out of gear, or can be increased to any other known less or greater pre-arranged amount, by having the spring on the pinion weaker or stronger than that on the wheel.

Both springs have, further, little hands, *h*, *h'* (seen in the figure), for setting them up, so that the whole deflection of 360° may, if desired, be produced by a small percentage of change in the total current when it is wished to measure accurately small changes in a fairly constant current. The wheel and pinion ammeter, then, furnishes an instrument for the measurement of strong currents, comparable in delicacy with the instruments usually employed for the measurement of only weak currents. Every bearing is jewelled as it is in a good watch, hence the freedom of motion is very great.

An ammeter on this principle we are now constructing, to measure p to 1,200 ampères.
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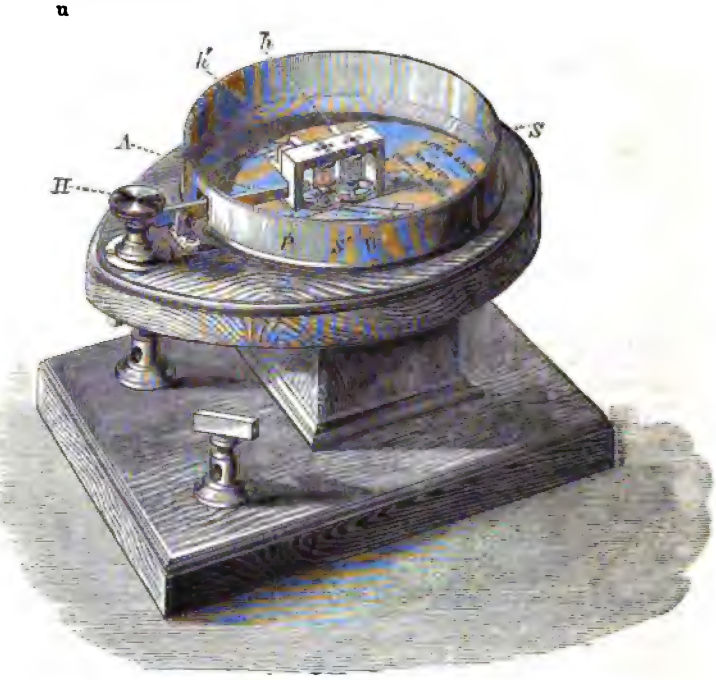


Wheel and Pinion Ammeter and Voltmeter.

On a similar principle, we have constructed wheel and pinion voltmeters, with two grades of sensibility, for measuring electromotive forces with great accuracy.

By means of simultaneous measurements of the currents flowing through a circuit, and the difference of potentials between its two ends, the horse-power electrically given to that circuit can be ascertained, since this horse-power equals A × V × ·00134, where A is the current in ampères and V the difference of potentials in volts; also A × V × 44·25 equals the number of foot-pounds of work per minute electrically given to that part of the circuit.

6. *Bifilar Suspension Electric Power Meter.*

In the paper read by us last spring at the Society of Arts, we described an electric power meter which we had arranged for measuring by one observation the horse-power electrically given to any part of the circuit, and which, by the employment of our commutator principle, could be calibrated by employing very much smaller powers than the instrument was intended to usually measure. At the York meeting of the British Association, we exibited the instrument which we had been employing for this purpose, consisting of a coil of very fine wire wound on a long thin bobbin, so that the coil had a very small moment of inertia, capable of moving about an axis parallel to the length of the bobbin. The coil was bifilarly suspended inside another fixed coil containing 10 thick wires, each of exactly the same resistance, and which, by means of the commutator, could all be joined up in series or in parallel.

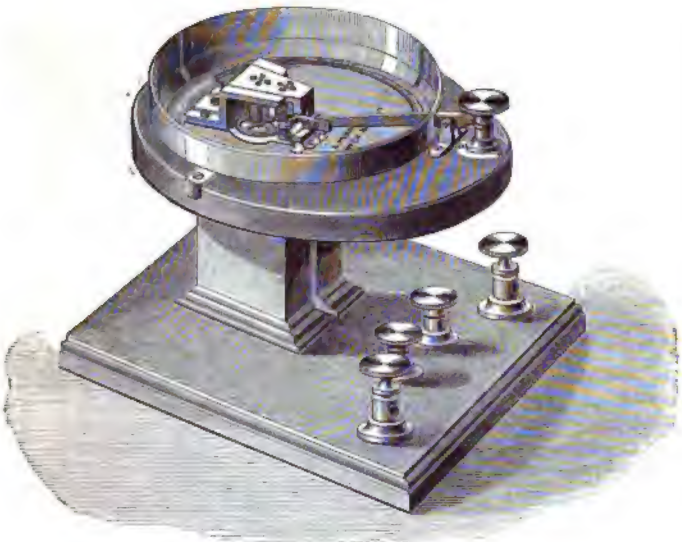
The thick wire coil is placed in the main circuit, while the fine wire coil acts as shunt to that part of the circuit, P, Q, the horse-power electrically given to which it is desired to measure. The current passing through this fine wire coil therefore measures V, the difference of potentials between P and Q, hence the deflection of the coil measures the product of the main current, A and V, and consequently

the horse-power being electrically given to P, Q. By turning the commutator to series, the sensibility of the instrument can be increased exactly ten times, either for the purpose of calibration, or when it is required to measure the power being given to, say, one incandescent light.

At the same meeting of the British Association, Sir William Thomson, before seeing our electric power meter, described an instrument he proposed constructing on the same principle, and which he called an electro-ergometer. We have not employed this name, because it appears to us to be not quite apt, since such an instrument measures the rate of doing work which is power, and not the *ergs* or amount of work done.

7. *Wheel and Pinion Electric Power Meter.*

This year we have modified our electric power meter, employing the wheel and pinion and double spring already described in connection with the wheel and pinion ammeter and voltmeter, so that this instrument now takes the shape shown in the following figure.



Wheel and Pinion Electric Power Meter.

The outer and larger binding screws are for taking the wires which form part of the main circuit; the inner smaller binding screws for the finer shunt wires which are attached to that part of the circuit, the energy electrically expended in which it is desired to measure. One or both springs can be employed, and so two very different grades of sensibility are possible; also a definite amount of angular set can be given to either, so that a small change in a large horse-power will cause a great change in the deflection of the pointer.

8. *Transmission Dynamometer and Dynamometer Coupling.*

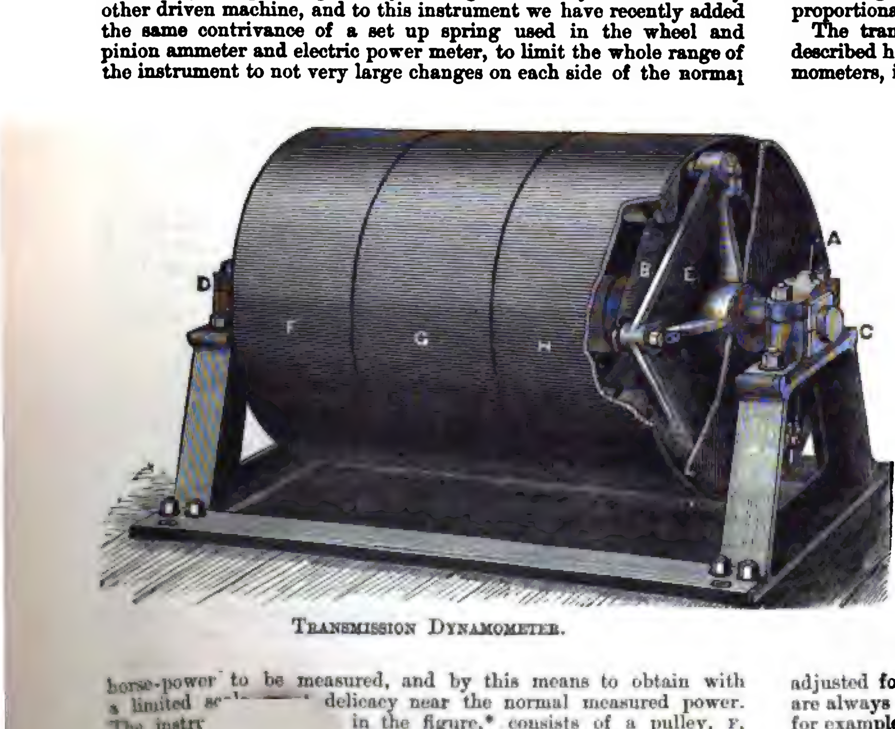
When describing our original ammeter to this society, we described a form of transmission dynamometer we had devised for measuring the power given by an engine to a dynamo or to any other driven machine, and to this instrument we have recently added the same contrivance of a set up spring used in the wheel and pinion ammeter and electric power meter, to limit the whole range of the instrument to not very large changes on each side of the normal horse-power to be measured, and by this means to obtain with a limited sc[illegible] delicacy near the normal measured power. The instr[illegible] in the figure,* consists of a pulley, F, rigidly fi[illegible]t, C D, a loose pulley, G, and a pulley, H, joined by the spiral springs, B, to the ribbed plate, E, which is rigidly fixed to the shaft, C D. If, then, the engine belt is on F, and the belt to the dynamo or driven machine on E, or *vice versâ*, the springs, B, will be stretched, depending on the "torque" or twist transmitted. The extension of these springs causes, by means of a small link-motion seen at the lower right hand curve of the figure, the bright bead, A, at the end of a long arm to approach the centre. Hence the smaller the radius of the circle described by this bright bead as it revolves, the greater the torque. Consequently, the horse-power transmited is at once obtained from observing the indicated torque and the speed of rotation. The arm carrying the bead is slightly flexible, and when no power is being transmitted the bead is pressed with a certain force against the rim of the front plate, hence the bead does not commence moving until a certain pre-arranged horse-power at a given speed is being transmitted; its whole radial motion, therefore, is completed for a certain additional transmitted horse-power, the necessary addition depending on the power of the springs and the leverage of the link motion. Consequently, a large change in the radius of the circle of light is produced by a small change in the transmitted horse-power. Further, one of the pins in the links can be taken out and put into another hole, which has the effect of greatly altering the leverage of the links, thus increasing the magnification and causing the motion of the bead to be completed for another range of power. For example, the springs and link motion may be so arranged that with one of the two adjustments the bead may commence to move when eight horse-power is being transmitted at a certain speed; the whole motion from the circumference to the centre may be completed, when the horse-power transmitted varies from eight to 12. With the other adjustment, the bead may start moving when four horse-power is being transmitted, and the entire travel of the bead from the circumference to centre completed by this transmitted horse-power increasing from four to six. Slipping either the driving or the driven belt on to the loose pulley, G, causes the transmission dynamometer and the dynamo machine to stop while the engine is going on.

The next figure shows our dynamometer coupling, which differs only from the preceding in that it is intended to be used with machinery driven directly by shafting where belting is not employed. For instance, this coupling may be used to measure the horse-power given by a fast-speed engine to a dynamo driven directly by it, or it may be employed to measure the power given by a marine engine to the screw or to the paddles, or generally the horse-power transmitted along any line of shafting; the spring coupling, in fact, replacing the ordinary coupling used with such shafts.

One of the halves of the coupling seen in the figure is keyed to the driving shaft—for example, the shaft of a fast-speed engine—and the other to the driven shaft—for example, that of the dynamo. The half, C, is attached to the other half by means of the spiral springs, and the stretching of these is therefore a measure of the torque. The angular motion of the one relatively to the other causes the bright bead, B, to approach the centre, and, as before, the radius of the circle of light measures the horse-power transmitted at any particular speed. The arm, E, carrying the bead, is also, as before, slightly flexible, so that when no power is being transmitted the bead, B, is pressed with a certain force against the rim of the larger plate. Hence the bead does not commence to move until a certain pre-arranged horse-power, at a given speed, is being transmitted, and the whole motion is completed for any pre-arranged excess beyond this, thus enabling delicate measurements to be made at powers a little more or less than that normally transmitted.

By a proper arrangement of the link-motions, we have succeeded in making the radial motion of the bead in both instruments exactly proportional to the extension of the springs or twist transmitted.

The transmission dynamometer and dynamometer coupling just described have the great advantage over any sort of laboratory dynamometers, in that the former have not to be put into position and adjusted for each particular experiment, but are always ready and are always indicating the power transmitted at any given speed. If, for example, a dynamometer coupling be inserted in the shafting of a factory in place of the ordinary coupling, a glance at it at any time will show the power that is being transmitted by it. If two such dynamometer couplings be inserted at two places in the same set of shafting, the difference between the transmitted powers indicated by



Transmission Dynamometer.

Dynamometer Coupling.

* The [illegible]ure are from blocks used in Professor Perry's book on "P[illegible]out to be issued by Messrs. Cassell, Petter, and Galpi[illegible]ed us the use in advance of these two illustrations.

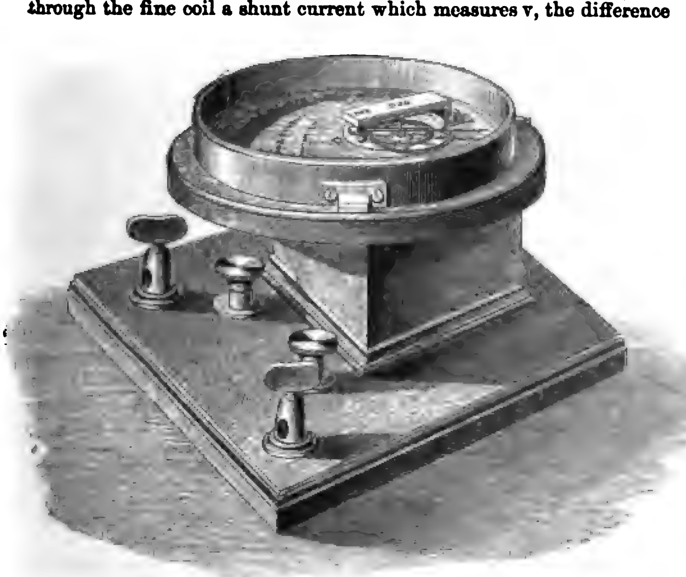
them is the power utilised by the machinery driven by that portion of the shafting that is between them. At present, masters of works, we think, have necessarily but rather a vague idea of the amount of power expended in different parts of their works—how much, for example, is used to drive one portion of the machinery and how much to drive some other The substitution of a few dynamometer couplings, at well-chosen places, for the ordinary couplings, would settle this question.

9. *Ohmmeter.*

The next instrument, which, like all the preceding electric ones, is constructed by Messrs. Paterson, of 76, Little Britain, is for the purpose of measuring the resistance of any part of, say, an electric light circuit, while the strong current is flowing. At present the resistances of the field magnets, the bobbins of electric lamps, &c., are measured with the Wheatstone's bridge when cold, and a guess is made at their resistance when hot by making a rough estimate of the temperature. A better plan than this is to stop the current, and quickly measure the resistance before the circuit has had time to cool; but even this method of measurement can only lead to approximate results, and is of course quite inapplicable to the resistance of either an arc or an incandescent light. In such cases it is usual to measure the main current in ampères with an ammeter, and the difference of potential in volts with a voltmeter, between the two terminals of the lamp, since dividing the second reading, V, by the first, A, we have the ratio $\frac{V}{A}$ or R, the required resistance. And this method we have been in the habit of employing, not merely to measure the resistance of a lamp, but the resistance possessed by any part of the circuit while the current was flowing through it.

To avoid, however, always having to take two measurements, we devised some months ago an instrument which we have at length perfected, for measuring the ratio at one reading, and this instrument, called an "ohmmeter," differs from the power meter in that, while the latter measures the product, V A, the ohmmeter measures the ratio, $\frac{V}{A}$.

This instrument consists of two coils, one of thick and the other of fine wire. Both coils are fixed, and with their axes at right angles to one another, and the currents flowing through each act on the same needle. Through the thick coil the whole current, A, flows, and through the fine coil a shunt current which measures V, the difference



Ohmmeter.

of potentials between the two ends of the part of the circuit the resistance of which it is required to measure; and the forces due to these two currents are at right angles to one another, hence the deflection of the needle may be made to measure $\frac{V}{A}$. By giving the proper mathematical shape to both the coils and to the needle, we have succeeded in obtaining the instrument seen in the accompanying figure, in which the deflections from zero are directly proportional to the values of $\frac{V}{A}$, that is, to the values of the resistances to be measured.

When the instrument is not in use, there is no directing force acting on the needle, and the pointer therefore remains anywhere. On allowing the main current to pass through the thick coil, by means of the outer and larger binding screws, the axis of the needle instantly places itself along the axis of the thick coil, and the pointer points to nought. If now wires be attached to each of the small binding screws belonging to the fine coil, and the other ends of these two wires be attached to the *same* point of the main circuit, the pointer still remains at nought, indicating that there is no resistance in the main circuit between the two points of attachment of the fine wires. If these wires be separated by, say, the field magnets of the dynamo, the pointer at once moves to a number indicating the resistance of the field magnets, &c. It will be seen, then, that the resistance of any part of the circuit can be measured at any time without interfering with the main current.

In actual practice, in fact, the ohmmeter is simply kept inserted in the main circuit anywhere, and when it is desired to measure the resistance of any part of the circuit, all that is necessary to be done is to connect, by means of two fine wires, the two ends of this part of the circuit to the two smaller binding screws of the ohmmeter.

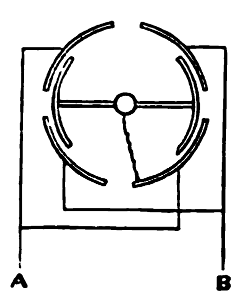
By the employment of the wheel and pinion, a deflection of about 320° of the pointer is obtainable, and on the present instrument a deflection of 60° corresponds with one ohm, so that measurement of resistances up to six ohms correct to 1-60th of an ohm can be accurately and quickly made. By altering the resistances of the two bobbins, the measured resistance corresponding with any particular deflection can be made anything we please.

One great use of the ohmmeter is that it enables us to dispense with resistance coils for experiments on dynamo machines. Any one who has used the resistance coils made for such purposes knows the difficulty of making coils of convenient size, whose resistances do not seriously alter with currents of 30 or 40 ampères. The coils cannot easily be made to cool fast enough to avoid the resistance seriously increasing with the current. We, on the other hand, use a bit of carbon, a bit of wet rope, or a pail of water, and measure with the ohmmeter the resistance of our extemporised resistance coil at the moment of making any experiment.

10. *Cylinder-spring Electrometer.*

For measuring differences of potential higher than 500 volts, the voltmeters already described are unsuitable, and recourse must be had to a portable modification of some form of Thomson's electrometer. We have devised two or three forms, one of which is seen on the table.

Two vertical pieces of metal, forming part of a cylindrical surface, are attached to a vertical arbor resting in jewelled bearings, and form the needle of the electrometer. This arbor is fixed to one end of an extremely fine spiral spring, the other end of which is fastened to the dial plate, which is itself electrically connected with one of the terminals, A. This spring serves two purposes—the one to give the needle directive force, the other for keeping up electric connection with the needle which turns inside four concentric vertical pieces of brass, which together nearly form a complete cylinder of a radius slightly larger than that of the needle, and which replaces the quadrant in the ordinary electrometer. These are electrically connected alternately in pairs, as shown in the small figure; and one pair is also connected with the needle through the very fine cylindrical spring, symbolically represented as a spiral line in the small figure. If, now, A and B be maintained at a difference of potential, E, a deflection, D, will be produced, which it may easily be shown is proportional to the square of E. One great advantage of this well-known method of connecting up the needle and quadrants of a Thomson's electrometer is, that although it does not produce as delicate an instrument as can be obtained by giving to the needle an independent charge, it enables the instrument to be used for measuring a rapidly-reversing electromotive force equally well as for



measuring a non-reversing electromotive force; whereas a fine wire galvanometer or dynamometer cannot be satisfactorily used for measuring even a small rapidly-reversing electromotive force, on account of the retardation arising from self-induction.

The advantage of the special modification above described of the quadrant electrometer is that it is portable; and from the needle having but a small moment of inertia, while at the same time it is everywhere very near the fixed attracting surfaces, the instrument may be made partly dead-beat, and at the same time sufficiently delicate to measure the large electromotive forces for which it has been designed.

If it is desired to measure the horse-power electrically expended in any portion, P Q, of a circuit conveying an alternate current, a measurement of the strength of the current may be made with a suitable ammeter, and a simultaneous measurement of the difference of potentials between P and Q with an electrometer. The following arrangement of the electrometer, however, enables the mean product of the alternate current and alternate difference of potentials between P and Q to be measured with the one instrument:—

Let it be desired to measure the energy electrically expended in a portion of the main circuit between two points, A and B, whose potentials are P and Q respectively. Connect these two points to the opposite fixed cylinders in the previous electrometer. Place in the main circuit, on either side of the portion, A B (say, on the A side), a resistance, R, having no self-induction, and let its farther end, C, of which the potential is S, be connected with the movable cylinder of the electrometer; then the deflection, D, measures the mean value of $(P - Q)\left(S - \frac{P + Q}{2}\right)$. Now connect the needle with A, instead of with C; then the deflection, D, measures the mean value of $(P - Q)^2$. Hence $D - D'$ measures the mean value of $(P - Q)(S - P)$, which is obviously R times the mean value of the energy expended on the portion of the circuit, A B.

A variation may be made in the second test, and which consists in

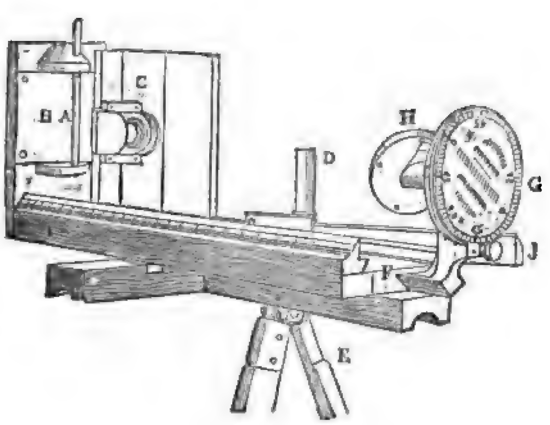
connecting the needle with a point, D, in the resistance coil, such that the resistance between D and A is $\frac{R}{2}$; in that case D″ will measure the mean value of $(P - Q)\left(\frac{S+P}{2} - \frac{P+Q}{2}\right)$, in which case D — D″ measures the mean value of $\left(\frac{(P - Q)\,(S - P)}{2}\right)$, or $\frac{R}{2}$ times the mean value of the energy expended.

12. *Dispersion Photometer.*

With this photometer measurements may be made in quite a small room of the illuminating power of the rays coming at any angle from even a powerful electric light. With the ordinary forms of photometer, the screen illuminated by the electric lamp must be placed so far away from the lamp that its brightness is the same as that of another screen, or of the other side of the same screen, illuminated by the standard candle. With the powerful electric lamps of the present day, a distance of 50 or 100 ft. is necessary, in order that a measurement may be made of the illuminating power by means of an ordinary photometer, and, in addition, it is very difficult to examine the light unless it comes from the lamp in a horizontal direction.

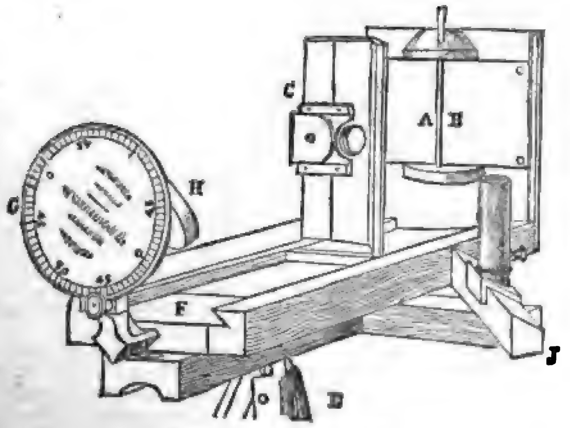
The principle of our dispersion photometer consists in the use of a concave lens to weaken the strength of the light (instead of placing the lamp far away from the screen), combined with the employment of a mirror turning round a horizontal axis, which makes an angle of 45° with its reflecting surface, in consequence of which rays coming at any angle from the lamp can be measured without the introduction of an error arising from the varying absorption at different angles of reflection; while at the same time a pointer attached to the mirror reads off on a graduated scale, G, attached to the instrument, the angle made with the horizontal by the beam of light under examination.

The instrument seen in the figures consists of a portable tripod stand, E, on which is screwed a small table, which is then carefully levelled.



DISPERSION PHOTOMETER.

The photometer is next placed on this table, and the pin at F, directly under the centre of the mirror, is passed through the base of the photometer into the hole in the table. The photometer, by turning round this pin, can, without producing any change in the distance of the centre of the mirror from the lamp, and therefore without changing the distance from the screen to the lamp, receive the small horizontal motion necessary for the adjustment for a new



DISPERSION PHOTOMETER.

inclination of the rays coming from the electric light. The divided circle, G, is clamped with the index at 0°, the electric lamp is lowered or raised till the illuminated disc formed on the screen of blotting paper, B, by the reflected light, passing afterwards through the lens, is [illegible] of the paper screen. A little sliding shutter with [illegible] its centre, seen in the figure, enables a very exact [illegible] made; but in practice we find that we get suffic[illegible] the use of the shutter. The instrument having b[illegible] the distance from the electric lamp to the centre o[illegible] measured.

The candle in the holder, D, sliding on the graduated rod, J, having now been lighted, there will be seen cast on the screen of blotting-paper, B, two shadows, side by side of the black rod, A, placed in front of it, one being cast by the standard candle, the other by the beam from the electric light after reflection at the plane silvered mirror, H, and dispersed in passing through the concave lens in the sliding wooden frame, C. The lens is now moved backwards and forwards until the intensities of these two shadows are equal when seen through the sheet of red glass supplied with the instrument, and again adjusted until the shadows are of the same intensity when seen through the sheet of green glass. *d*, the axial distance of the lens from the screen, as shown by the pointer attached to the lens frame on the fixed graduated scale, as well as *c*, the distance of the candle, also shown by position of its pointer on its graduated scale, are now noted; whence if *f* is the focal length of the lens, and if D is the distance of the lamp from the paper screen (that is, the distance of the lamp from the mirror, plus the fixed distance of the mirror from the screen), and if L is the strength of the examined source of light in standard candles,

$$\sqrt{L} = \frac{D - d}{c} \cdot \left\{ 1 + d\left(\frac{1}{f} + \frac{1}{D - d}\right)\right\},$$

or

$$L = \frac{1}{c^2}\left\{ D + \frac{d(D - d)}{f} \right\}^2.$$

We prefer to employ the formula; but as all the common instruments which have hitherto been manufactured have lenses whose focal length is four inches, we have prepared a table, a copy of which is sent out along with each instrument, in which the value of L is given for various values of D, *d*, and *c*. Using this table, it is necessary to have the lamp at either 60, 120, or 300 inches from the screen; the candle is either at 10, 14·14, or 20 inches from the screen; and the table is made out for every half-inch of the lens-scale. But inasmuch as we find that the improved arrangement of the mirror already referred to constitutes perhaps the most useful part of the instrument, and as the use of this improvement involves many alterations of D, Mr. Sennett, of the Kirby Street Engineering Works, Hatton Garden, the manufacturer, proposes in future not to furnish any table of the values of L unless specially asked for.

In these instruments we find that from 30 to 34 per cent. of the incident light at 45° is absorbed, whether this light is of ruby-red or signal-green colour, and practically none by the lens; so that we have the easy rough practical rule for all cases—add one-half to the measured intensity of light reflected. For more accurate working the exact absorption of the mirror of the particular instrument employed is used.

The intensity of the horizontal beam having been measured, the electric lamp is now raised or lowered and fixed in any position; a few seconds suffice to turn the mirror so that it sends its centre ray exactly through the centre of the lens. The distance from screen to mirror in this instrument being 22 inches, if δ is the distance from centre of mirror to vertical from lamp, and if θ is the angle of elevation, then

$$D = 22 + \delta \sec. \theta.$$

Using this value of D in the formula above, and adding one-half to the strength of the light to make up for absorption, or making the more accurate correction for the special instrument employed, the true intensity of the light in standard candles can be ascertained. In practice, if an electric light is moderately steady, ten measurements may be made, with some confidence in their accuracy, in two minutes; and the light may be measured in ten different positions, from an angle of depression of 60° to an angle of elevation of 60°, 100 observations being taken in less than half an hour.

We may mention one very important result we have been led to by the systematic employment of a photometer which can be used close to the electric light, and that is the large amount of absorption that occurs on certain days when the rays from strong electric lights, and especially the green rays, pass through the air, which appears to the eye perfectly clear. At first we were inclined to think the higher results for the candle-power of a lamp obtained with our dispersion photometer than those obtained with an ordinary distance photometer were due to some error in our photometer itself; but we have since ascertained that this is due to the absorption of the air, because we find that, if simultaneous measurements are made with ordinary Rumford's photometers, each without lens or mirror, placed at different distances from the lamp in the same azimuth and in the same horizontal plane, the nearer one gives, as a rule, the highest readings, and the difference is the greater the stronger the light, and is greater if the light be examined at each photometer with green glass. The importance of such experiments in connection with the penetrating power of the electric light must be obvious.

13. *Electric-light Calculator.*

Having had occasion to make a large number of calculations of the illuminating power of various electric lamps, the horse-power electrically given to them, and the "efficiency" or number of candles per horse-power produced, we have devised and had constructed a simple piece of apparatus by means of which all the necessary calculations can at once be made, and which, after being used to work out the results obtained from any one experiment, preserves, until it is again used, a record of all the numbers employed in the previous calculations—an arrangement which serves as a valuable check in preventing clerical errors. The apparatus consists of four concentric discs graduated logarithmically, after the manner of the slide rule. The observed distance of the electric light from the photometer screen is sought for on scale 1: opposite this is brought the observed distance of the candle read off on scale 2, and

the pointer shows at once the candle-power of the lamp. On scale 3 is read off the current in ampères passing through the lamp, and opposite this is brought the observed difference of potentials in volts between its terminals read off on scale 4, when the second pointer shows at once the horse-power electrically given to the lamp. Finally, the illuminating power as shown by the first pointer is brought opposite the horse-power, as shown by the second, when the number of candles per horse-power is at once read off.

14. *Coulombmeter.*

We have also, mainly for the purpose of experimenting on charging and discharging Faure's accumulators, arranged an apparatus which registers the total quantity of electricity that has passed through it in any previous given time—an apparatus, in fact, which acts for electricity as a gas meter acts for gas. This coulombmeter is simply a small magneto-electromotor placed as a shunt to the main circuit, and acted on by *fluid friction*, which forms the essence of the apparatus, since such fluid friction opposes a resisting force directly proportional to the velocity, while, on the other hand, the force causing motion is proportional to the current; hence the current flowing is proportional to the velocity, and the total quantity of electricity that flows in any time is proportional to the total number of revolutions made by the motor in that time, which are counted by an ordinary speed-counter attached to the revolving spindle. Hence the number of coulombs of electricity that have passed may be measured, by taking two readings of the counter, as easily as can the number of cubic feet of gas consumed by taking two readings of the gas meter.

This coulombmeter we have used for some time; but we have found this week that an instrument somewhat of this nature was patented some time back by Mr. Edison, although we are not aware that he has ever used it, or whether he realises the absolute necessity of the existence of a fluid friction. To him, however, we must yield up the priority of invention for this form of coulombmeter.

We have a strong current available, and we will now proceed to test experimentally all these various instruments which you see in the room before you, and which have been designed and constructed in each case to supply an actual need, which our experiments led us to see existed, for exact, portable, and moderately cheap measuring instruments for use in electric lighting and electric transmission of power.

GROVES'S DISCHARGE KEY.

THE discharge keys in general use perform three operations —charge, insulate, and discharge. Mr. Robert Sabine, however, to suit his own testing arrangement, introduced an additional lever and cam by which the three contacts are brought into metallic connection, thus short-circuiting the key. The design of such keys is of a mixed character, and, although made of high insulating material, they are not provided with any protection from light, air, and dampness, consequently they somewhat rapidly deteriorate and require careful preparation before use.

The key about to be described will perform the four operations above mentioned, and is made with protection for the contacts and insulation, especially the principal (cable) terminal, and the design is of a general character. Fig. 1 represents the external appearance. A is a brass case with glass cover, D, having a hole through which passes the cable terminal, C; there is a space between the glass cover and the terminal which is closed when not in use with an ebonite disc or washer which slides upon the terminal. This said terminal passes through a hole in the base and is prolonged under the ebonite slab to the frame, thus giving six inches of insulation, and it is protected from light and air. On

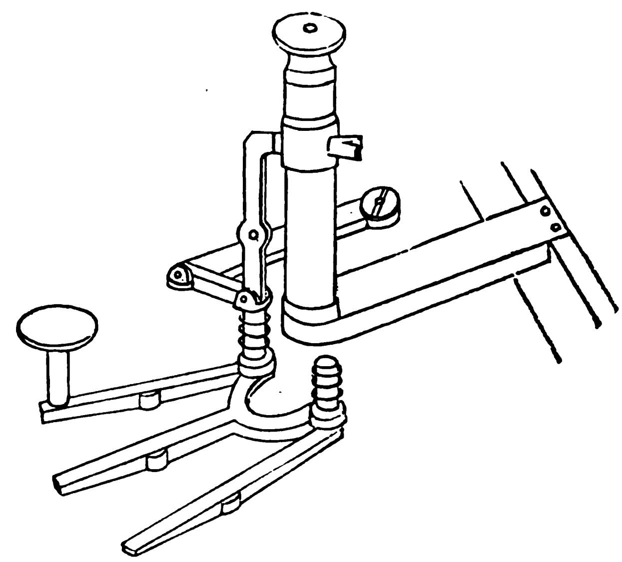


FIG. 2.

each side of the upper end of the cable terminal is fixed a V-shaped contact stud, into which the end of a crank lever is pressed, the pressure being given by a spiral spring when a lever connected with the studs is raised. The terminals, G and B, are well insulated, but they are not so important as the cable one.

Fig. 2 is a sketch of the working arrangement. One of the crank levers is left out to prevent confusion. The studs are arranged in a similar manner to those employed in Wheatstone's A B C instruments, consisting of pulleys and a chain; when one stud is depressed the one already down is raised, and only one can be pressed down at a time. The merits claimed for this key are certainty in its action and easiness of manipulation (it only necessitating the depression of one of the studs, S, to produce the result required), high insulation, and the protection of the contacts. A vessel of sulphuric acid can be placed in the case to absorb any moisture that may have got in.

The maker of this key is Mr. Groves, of 89, Bolsover Street, W., and he is doubtless well known to most of our readers as having formerly been the assistant of the late Sir Charles Wheatstone, for whom he carried out many of his most important experiments.

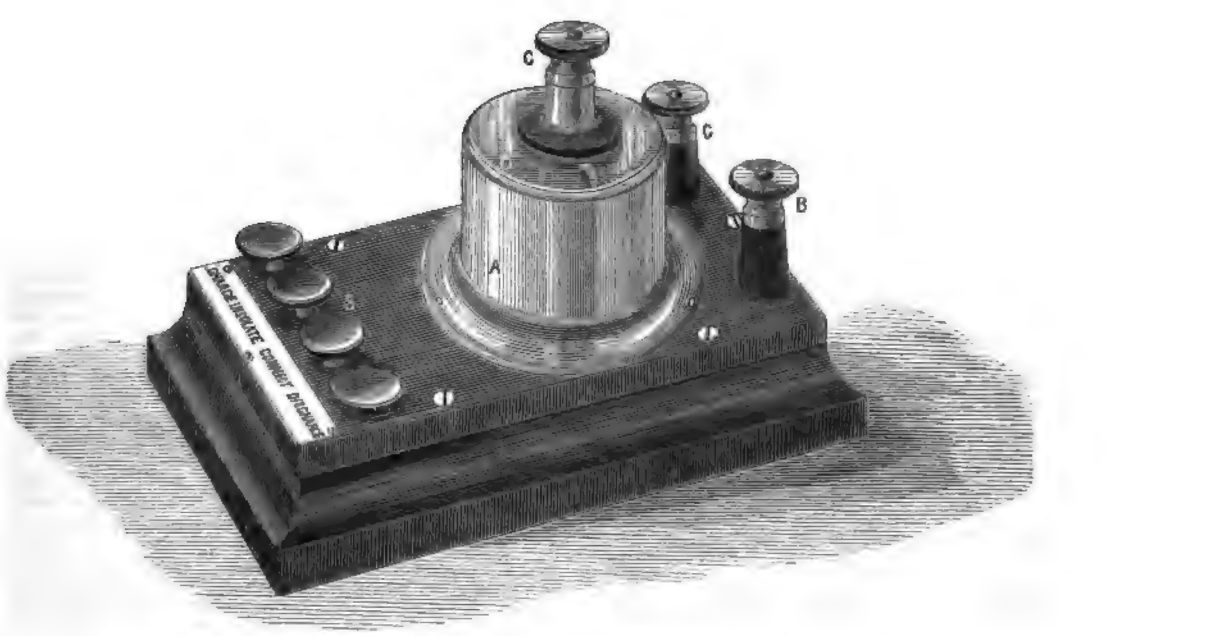
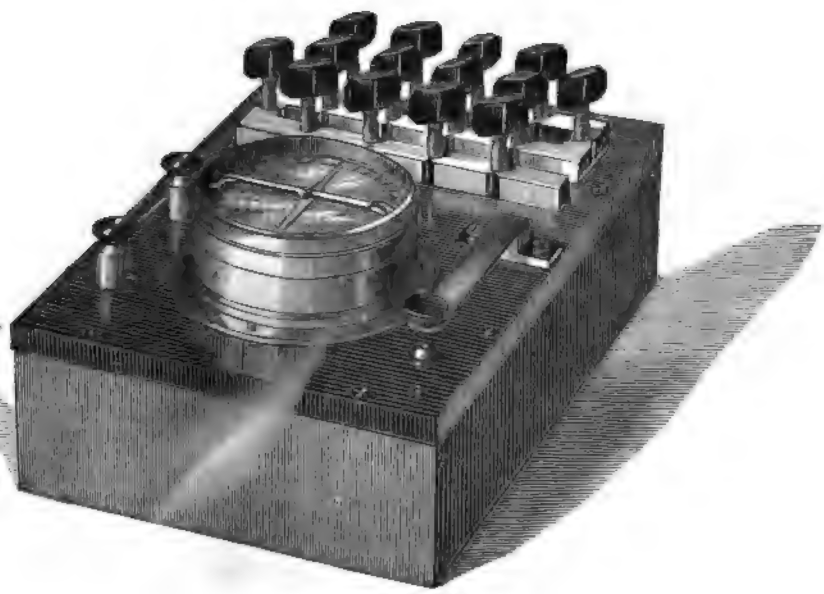


FIG. 1.

SIMMONS'S PORTABLE TESTING BOX.

WE have recently had an opportunity of examining and using one of these very useful and compact testing boxes for measuring resistances. That with which we have been operating is arranged to measure from 0·01 to 20 ohms. The resistances are made up as follows: ·01, ·02, ·02, ·05, ·1, ·1, ·2, ·5, 1, 1, 2, 5 and 10 ohms. There is also an "infinity" plug, so that the adjustable resistance may be broken.

The "Wheatstone bridge" method is not employed in this apparatus, and we need, therefore, scarcely inform our readers that the galvanometer is wound differentially. We believe that each side has a resistance of about 15 ohms. The battery consists of four small Leclanché elements of the medical type, connected up for quantity, and virtually forming one large cell. This is fixed in the interior of the box, and the various connecting wires are permanent and hidden from view. The wire or coil whose resistance is unknown is attached to the two binding screws, and the adjustable resistance unplugged, until no movement of the galvanometer needle is observed. A contact key is



arranged on the box for the purpose of putting the battery in circuit. The sensitiveness of this instrument is such that resistances can be easily measured to two places of decimals; and if greater accuracy be desired, it can be obtained, as is sometimes done with the "Wheatstone bridge" arrangement, by proportional deflections. For all practical purposes the second decimal place suffices, except in such an extreme case as measuring, for instance, the armature resistance of a large Edison dynamo-electric machine. Mr. Simmons, however, makes up the various resistances contained in his boxes for any particular requirements.

Mr. Simmons for several years took a prominent position in the business of Messrs. Elliott Brothers, and this fact alone is sufficient to guarantee excellence and accuracy of workmanship, together with an electrical knowledge of no common order. We should imagine that such an apparatus would be of great service to electric light engineers, especially to those members of the profession who are continually travelling about, installing the electric light in various towns. The veriest tyro can manipulate this instrument after its operation has once been explained, for electrical knowledge is not necessarily requisite. We can cordially recommend this testing box, and we do not doubt but that Mr. Simmons will find his compact combination se[illegible]

Th[illegible] shows all that is necessary in order to [illegible] construction of the apparatus, and it is [illegible]avelling case, 11 by 8 by 5½ inches.

THE BRITISH ASSOCIATION.

[*Specially reported for the* ELECTRICAL REVIEW.]

THE ELECTRO-MAGNETIC PRACTICAL SYSTEM OF UNITS.

[Paper read by Dr. C. W. SIEMENS, before Section A, Tuesday, 29th August, 1882.]

SINCE referring to the subject of electrical units in my presidential address, I have been requested by several members of this section to bring the matter again before you, to afford an opportunity for its fuller discussion. I have great pleasure in acceding to the request, as I am most anxious to hear the views of the members of this section on the several units which I ventured to add to the list decided on at the Paris Electrical Congress.

At this Congress, which was attended officially by the leading physicists of all civilised countries, the attempt was successfully made to bring about a union between the statical system of measurement that had been followed in Germany and some other countries, and the magnetic or dynamical system developed by the British Association, also between the geometrical measure of resistance, the (Werner) Siemens unit, that had been generally adopted abroad, and the British Association unit intended as a multiple of Weber's absolute unit, though not entirely fulfilling that condition. The Congress, while adopting the absolute system of the British Association, referred the final determination of the unit measure of resistance to an International Committee, to be appointed by the representatives of the several Governments; they decided to retain the mercury standard for reproduction and comparison, by which means the advantages of both systems are happily combined, and much valuable labour is utilised; only, instead of expressing electrical quantities directly in absolute measure, the Congress has embodied a consistent system, based on the ohm, in which the units are of a value convenient for practical measurements. In this, which we must hereinafter know as the "practical system," as distinguished from the "absolute system," the units are named after leading physicists, the Ohm, Ampère, Volt, Coulomb, and Farad.

I would venture to suggest that two further units might, with advantage, be added to the system decided on by the International Congress at Paris. The first of these is the unit of magnetic quantity or pole. It is of much importance, and few will regard otherwise than with satisfaction the suggestion of Clausius that the unit should be called a "Weber," thus retaining a name most closely connected with electrical measurements, and only omitted by the Congress in order to avoid the risk of confusion in the magnitude of the unit current with which his name had been formerly associated.

As Clausius has shown, the unit of pole in absolute measure must be multiplied by the factor 10^8, in order to make the Weber consistent with the practical system. With greater diffidence I would submit two other units, which, I think, would be of considerable service in practical work. Firstly, the unit connecting heat measurements with the electrical system. Hitherto the unit of heat has been taken variously as the heat required to raise a pound of water at the freezing point through 1° F. or C., or, again, the heat necessary to raise a kilogramme of water 1° C. The inconvenience of such a unit so entirely arbitrary is sufficiently apparent to justify the introduction of one based on the electro-magnetic system, *i.e.*, heat generated in a second by the current of an Ampère flowing through the resistance of one Ohm. In absolute measure its value is 10^7 C.G.S. units, and assuming Joule's equivalent as 42,000,000, it is the heat necessary to raise ·238 grammes of water 1° C., or approximately 1-1000th

of the arbitrary unit of 1 lb. of water raised 1° C. Such a heat unit might with great propriety be called the Joule.

The last unit I should suggest adding to the list is that of power. The power conveyed by a current of an Ampère through the difference of potential of a Volt is the unit consistent with the practical system. It might be appropriately called a Watt, in honour of that master mind in mechanical science, James Watt. He it was who first had a clear physical conception of power, and gave a rational method of measuring it. A Watt then expresses the rate of an Ampère multiplied by a volt, whilst a horse-power is 746 Watts, and a cheval de vapeur 735. Accepting the Joule, the Watt can be briefly defined as a Joule per second.

The definition of the Joule which I have given leads, no doubt, to a somewhat small—perhaps inconveniently small—value to heat measurements; but the advantages of consistency with the other units appear to me to outweigh any inconvenience there may be in this respect. The complete system of electro-magnetic units would then be:—

(1) Weber,	unit of	magnetic quantity =	10 C.G.S. Units.
(2) Ohm	,,	,, resistance =	10^9 ,,
(3) Volt	,,	electromotive force =	10^8 ,,
(4) Ampère	,,	,, current =	10^{-1} ,,
(5) Coulomb	,,	,, quantity =	10^{-1} ,,
(6) Joule	,,	,, heat or work =	10^7 ,,
(7) Watt	,,	,, power =	10^7 ,,
(8) Farad	,,	,, capacity =	10^{-9} ,,

At the Paris Congress Sir W. Thomson suggested that the unit of magnetic field would be a useful addition, and pointed out that it would be proper to attach to it the name of Gauss, who first theoretically and practically reduced observations of terrestrial magnetism to absolute measure. It is a point for discussion as to what would be the definition of the Gauss, to keep it consistent with the other units. Defining it in the way perhaps most obvious, as the strength of field produced by a Weber at the distance of one centimetre, its value would be 10^8 C.G.S. units, but this is certainly inconveniently large, consequently I have considered it advisable to omit it from the list, and leave it in the form originally proposed by Sir W. Thomson, as the absolute unit of magnetic field.

(To be continued.)

NOTES ON ATMOSPHERIC ELECTRICITY.

[Paper read by C. MICHIE SMITH, B.Sc., F.R.S.E., Professor of Physical Science in the Madras Christian College, at the Meeting of Section A, on Wednesday, August 30th, 1882.]

BEFORE leaving for India in the end of 1876, it occurred to me that as almost nothing seemed to be known about atmospheric electricity in the tropics, it would be well if I could take with me the apparatus necessary for making observations on it. I accordingly communicated with Sir W. Thomson, who kindly obtained for me a grant from the British Association for a portable electrometer. This instrument I took with me, and the following are the results of the observations made with it. During the voyage a number of observations were made, but of those only two sets were of any special interest. The first of these was made in the Suez Canal, on December 22nd. At 8 a.m., at noon, and again at 8 p.m., the readings showed a negative electrification, of from three to eight divisions of the scale, the weather being entered as "fine and bright," and the wind as "S., very light," "E. by S., light breeze," "E.S.E., light," respectively; while readings taken at 1.30 p.m. and 7.30 p.m., gave a positive electrification of eight divisions on each occasion. This has considerable interest in connection with some observations made at Madras. The other set was made in the Red Sea during a rather violent squall. In this case the readings varied very rapidly from strong + to strong —, readings 1½ hours before having been + 18 divisions. The variations took place so rapidly that no quantitative observations could be made, and in a few minutes, when the squall had passed over, the readings were found to be much as before + 17 divisions. In Madras, a series of observations were made, extending from 17th January to 4th March, 1877. These were made at 8.30 a.m. and 6 p.m., and showed a wonderfully steady state of electrification, varying from a maximum of + 53 to + 19, with an average of + 33. The morning and evening readings usually agreed very closely. In every case the electrification was positive, and the weather very fine without any rain. During this time the electrometer had to be recharged every two or three days, an operation which, though very simple in this climate, is by no means so simple in a climate so moist as that of Madras. After a time I found it impossible to continue the observations at all, and sent the instrument home to see if it could be in any way modified so as to suit the climate. On its return, after a long delay, I found it leaked as badly as before, and so rendered observations almost impossible. The reason is doubtless to be found in the circumstance that the air of Madras is not only moist, but is also very full of small particles of salt, which are constantly being carried from the surf by the sea breeze. The glass of the jar soon gets coated with these particles, and no amount of simple drying will make the insulation good. That the fault did not lie in the jar itself I have tested since my return to this country, for I find that here the leakage is less than 1·5 per cent. per diem, while in Madras it was often over 30 per cent. per diem.

On account of these difficulties I was unable to make any long series of observations, but in July of 1881, I made a few that were specially interesting as being the only ones in which I have observed negative electrification in Madras, except during the thunderstorms. The observations were as follows:—

July.	p.m.			Reading.
5	1	Strong land wind.	Temp. 94° F.	—74
6	,,	,,	,,	—16
7	,,	,,	,,	0
,,	2·20	,,	,,	—15

In each case local showers within three or four hours. These observations are, of course, too few to form any theory upon, but those acquainted with the peculiar sensations produced by the land wind in Madras, will feel that the point is worth investigation, and I hope on my return to Madras to be able to take with me improved apparatus with which to continue the observations.

ON SECONDARY BATTERIES, WITH SPECIAL REFERENCE TO LOCAL ACTION.

[Paper read by Dr. GLADSTONE, F.R.S., before Section A, Friday, August 25th.]

THE high hopes that were originally entertained of the Planté battery and its various modifications have scarcely been realised as yet, and one main cause of this is to the extent to which their efficiency is apt to be reduced by local action. The positive element is always metallic lead, the negative element peroxide of lead, and the binary liquid dilute sulphuric acid. Now the peroxide of lead, which constitutes the negative plate, is itself supported by a sheet of lead, and both are immersed in acid. Voltaic action necessarily takes place, therefore, between the elements of which this plate is composed; the lead is converted into sulphate of lead, while the peroxide is reduced to protoxide, which immediately combines with some of the excess of acid to form sulphate of lead and water. As however this insoluble salt is produced on the surface of the metallic sheet, and of the peroxide crystals, a barrier to further action is speedily formed; but, as the amount of force which can be obtained from one of these cells depends upon the amount of peroxide that is capable of being reduced, the value of the cell is *pro tanto* diminished. This local action may have taken place to a great extent without its being recognised. On joining the negative and positive plates the current that instantly ensues is of almost the full strength, and the electromotive force is still 2·0 volts, or thereabouts. It is only when the cell has been allowed nearly to exhaust itself that the loss of power through the destruction of the peroxide makes itself evident by the smaller amount of work done.

This local action is not stopped, though it is probably diminished, by the discharge taking place between the negative plate and the positive one. It takes place also during the formation of the cell, as is evidenced by an absorption of oxygen greater than would be required merely for the oxidation of the minium used in Faure's process, and by the continuous absorption of a small quantity of oxygen for days after the main action is complete.

This defect of the existing secondary batteries is probably to be overcome by some modification of the elements employed in their construction.

(To be continued.)

ON SOME APPARATUS FOR USE IN CONNECTION WITH ELECTRIC LIGHT MEASUREMENT.

[Paper by ROBERT SABINE, C.E. Read before Section G, Aug. 29th.]

HAVING occasionally to make measurements requiring some degree of exactness of the electrical and photometric values of electric light systems, in reference to the power expended in maintaining them, I had for some time difficulty in finding apparatus specially adapted for this work, the electrical instruments which were suitable for continuous current systems being, as a rule, unsuitable for alternate currents. I was therefore induced to design some apparatus for my own use, which I have found convenient and sufficiently exact for practical purposes.

I. THE PHOTOMETER.

The absorption of light when passing through translucent media has hitherto been almost entirely unemployed for photometric purposes. Lampadius, it is true, suggested the reduction of any ordinary light to its vanishing point by means of thin sheets of horn, assuming that this vanishing-point might be taken as a fixed unit of intensity—a method which De Limency and Secretan proposed to modify by employing sheets of paper instead of horn—and Count Xavier de Maistre and Quetelet suggested the employment of wedges of blue glass for purposes of stellar photometry. But in neither instance was anything approaching to a practical photometer produced.

The photometer which I am about to describe is based upon the partial equalisation of any two lights under comparison, by interposing in the path of the rays of each light a sufficient thickness of absorbing material, the final adjustment being made by a slight alteration of the relative distances of the lights from the photometer.

Instead of comparing the lights directly with each other, I find that much better results are obtained by comparing them singly with a third light, which is constant.

This constant light I obtain by allowing the rays from a small portion of the bright part of a paraffine flame to pass through suitable diaphragms; the advantage of this method being that so long as the diaphragms are not too large, any trifling irregularity in the paraffine flame, through burning higher or lower, does not affect the small portion of the bright part which is employed, and therefore the utilised light is practically as nearly constant as possible. The form of apparatus which I use is shown in section in fig. 1, in which the photometer is placed, for convenience of illustration, vertically, as if measuring a light immediately above it. The graduated scale, a, a^1, upon which the photometer travels, turns upon a centre carried by a stand (not shown in the drawing), and can be elevated or depressed to any desired angle. The photometer consists of a square box, d, d, on one side of which is a draw-tube and eye-pi

lens, g; and on the other side a tube, f, carrying a collar by which the paraffine lamp, b, b, is supported, and may be kept in a vertical position at whatever angle the scale may be directed. The chimney of the paraffine lamp is of copper, and opposite to the bright part of the flame, is provided with a tube, c, in which are a thin pane of glass and two diaphragms, and at the back another tube, c^1, in which a dark glass is fitted for observing, from time to time, the flame, to ascertain that it is burning in the proper position.

At p_1 is a thin sheet of translucent material, part of its inner surface being observed direct by the eye at g.

The light to be measured is placed at a distance (under three feet if possible) beyond the end, a, of the scale, so that its rays fall upon the face of a thickness of translucent material, p, inserted in a suitable guide at the side of the photometer, its inner surface being observed

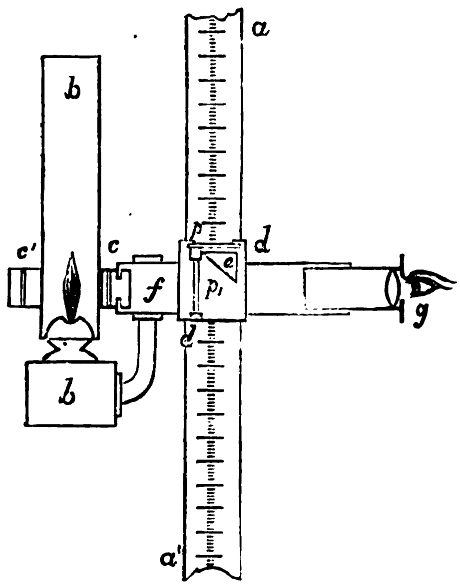


FIG. 1.

by the eye at g, reflected by the prism, e, which occupies half of the field of view. The thickness of the interposed translucent material, p, is adjusted until the illuminations of the two halves of the field of view are as nearly equal as this adjustment allows; then the distance between the light to be measured and the face of p is adjusted by causing the photometer, which is mounted on rollers, to travel on the scale until the two halves of the field of view are equally illuminated.

The illustration shows the photometer directed vertically upwards; but as the lamp may be turned with the collar which supports it, the scale may be placed horizontally or inclined at any desired angle upwards or downwards. In order to lessen the effect upon the eye of slight differences of colour between the lights to be compared, there are inserted just at the top and bottom of the line in which the two halves of the field of view meet, small strips of highly coloured glass. The effect of the presence of these, when I am observing, is to render the eye partly unconscious of small differences of tint of the middle portions of the field of view, without reducing its sensitiveness for appreciating the balance of illuminating effect.

The comparison with the horizontal light of a standard candle is done by placing the photometer horizontally and putting the candle at the end, a, of the scale, reducing at the same time the thickness of the translucent material, p, until a balance is nearly obtained, and finally adjusting by sliding the photometer along the scale.

The intensity of the light which penetrates from the paraffine lamp to the inner surface of the translucent sheet, p_1, and which is the constant of comparison, we will call λ. We may assume that of the light which falls upon the surface, p, the fraction which is scattered and reflected bears to it a constant relation, r.

Let L be the illuminating power of the measured light in the direction of the photometer, n the thickness of absorbing material, and D the distance of the source of light from p. Then the light which reaches the surface of p when a balance is obtained will be:—

$$\lambda = \frac{(1 - r)\,\mathrm{L}\,m^n}{\mathrm{D}^2},$$

m being the co-efficient of translucency of the absorbent body, p; that is to say, the intensity of light which succeeds in reaching the inner surface of a unit thickness of p, when a unit intensity of light enters the outer surface.

Similarly, for the standard candle, the illuminating power of which is l, its distance, d, and the interposed thick of the same translucent material, n_1:—

$$\lambda = \frac{(1 - r)\,l\,m^{n_1}}{d^2},$$

the relation of these two lights is, therefore:—

$$\frac{\mathrm{L}}{l} = \left(\frac{\mathrm{D}}{d}\right)^2 m^{n_1 - n}$$

it being assumed that the light of the paraffine lamp has remained constant during the two observations, and that the atmosphere has not acted as an absorbent.

The co-efficient of translucency of the interposed absorbent material must, of course, be very carefully determined, because upon the value of this co-efficient being exactly known depends the accuracy of the results obtained as much as upon the accuracy of the final adjustment of distance.

This co-efficient I determine by employing a strong steady light, and taking observations of distance first with one, then several (say, n) thicknesses of the material.

If the observed distance with one thickness is d_1, and that with n thicknesses is d_n:—

$$m = \left(\frac{d_n}{d_1}\right)^{\frac{2}{n-1}}.$$

I find that the readiest way is to take alternately the distances with one and three thicknesses, because then

$$m = \frac{d_3}{d_1}$$

a simple relation which saves calculation.

The comparison of one with two thicknesses was found to be objectionable, as any error of observation was exaggerated, whereas when more than three were taken for the co-efficient the illumination of the field became weakened, and the observations were less accurate.

It is not necessary that the translucent body at p_1 should be either of the same quality, tint, or thickness, as that used at p, as it is simply intended to provide a constantly illuminated surface for comparison; but the thicknesses of the material used at p must be carefully selected, and must be as uniform as the eye is capable of detecting. The material which I have found to be most convenient for use as an absorbent, consists of thin plain photographic paper, which is very uniform in texture, and is easily procurable.

In an earlier form of this photometer, the comparison was made direct with a standard candle, by enclosing the latter in a candle-holder consisting of a closely-fitting tube, furnished with a spring, which pressed the candle up against a top rim, and maintained it at a constant level in a suitable dark lanthorn.

It was found, however, that a candle so circumstanced always gave a reduced light, and that other lights compared with it appeared to be exaggerated in photometric value; moreover, the difference of colour between the light of a candle and that of most electric arc lamps, is very striking, while the colour of a paraffine flame is between the two, and the difference, therefore, between it and either the candle or electric light is less embarrassing.

When it is desired to employ Schwendler's method of observing the illuminated surfaces through coloured glasses, I place them before the eye-piece, g.

II. THE CURRENT DYNAMOMETER.

The current dynamometer is constructed to be equally applicable to continuous and alternate currents.

It consists of two circular flat coils of thick copper, a and b, as shown in outline in fig. 2.

One of the coils, a, is carried on a beam, together with a counter-weight, by a bifilar suspension. This suspension is done by a thin silk thread, the two ends of which are fixed to a torsion-head at d,

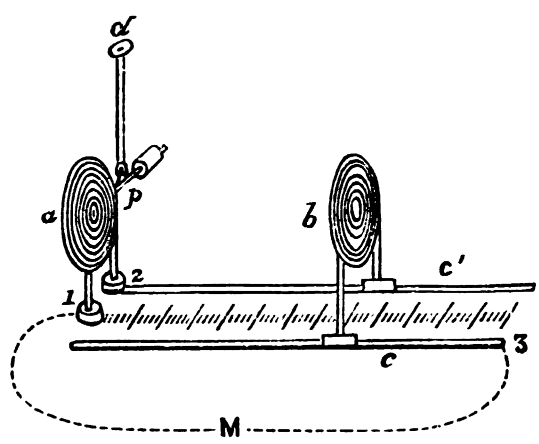


FIG. 2.

its middle portion passing under a small friction pulley, p, attached to the beam. By this means the strain upon both sides of the bifilar thread is equal. The ends of the movable coil, a, are amalgamated, and dip into two suitable mercury cups (1 and 2). In the position of rest, the torsion-head of the bifilar suspension is turned so that the plane of the coil, a, forms an angle of 5° to 10°, with the plane of the coil, b; its angular position being observed by a mirror attached to the suspended coil, which projects a spot of light upon a scale placed at a constant distance. The second flat coil, b, is mounted upon grooved copper feet, which slide upon two copper rails, c, c^1, keeping coil b at right angles to the rails and facing coil a, but at distances which may be readily varied.

The dynamometer is inserted in the circuit whose current is to be measured, between terminals connected with the points 1 and 3. The current from M enters the system at the terminal connected with the mercury cup (1), circulates (right-handed) through the suspended coil, a, which it leaves by the mercury cup (2), passes along the c^1, to the sliding coil, b, in which it circulates (left-handed), passes the rail, c, and so back to the circuit.

The repulsion which takes place between the coils, results, of course, in the deflection of the suspended coil to a greater degree, according to the strength of the current and the

between the coils. If this deflection is insufficient to place the coil, *a*, parallel to coil, *b*, the latter is slid along the rails nearer to *a*; but if the repulsion cause *a* to be deflected beyond its parallel position, coil *b* is drawn back until the light point settles to the zero of the scale.

The sluggishness of the mercury in the cups is utilised to check any continued oscillation.

The scale of the instrument is placed between the rails. It was calibrated by comparison with a tangent galvanometer, the position of the sliding coil, *b*, when the parallel position of the suspended coil was obtained, being marked for each ampère of current; and it was found that, beyond one ampère, the distance was practically proportional to the current; but below one ampère this proportion did not obtain, probably due to want of symmetry in the coils themselves.

As the deflection of the suspended coil is always the same, the repelling force acting upon it is constant; and if this force is directly proportional to the square of the current, and inversely to the square of the distance between the coils, it would follow that the current and distance should be directly proportional to each other.

The resistance to deflection of the suspended coil must, of course, be kept as constant as possible. This I have attempted by using unspun silk for the bifilar suspension, and putting the threads at a sufficient distance apart to cause the resistance to deflection to be due more to the lifting of the coil than to the torsion proper of the threads.

By making the current go through the two coils in derived circuit instead of in series, the sensitiveness becomes reduced to half; the range of the scale being proportionately increased. For very strong currents the range of the scale can be increased to any extent by properly arranged shunts.

When measuring very strong currents the disturbing effect of the earth's magnetism has to be considered. In order to allow for this, before making an observation I place a coil of wire of the same resistance as one of the working coils, but double-wound, upon the rails in place of *b*. This dummy coil has no deflecting effect upon the suspended coil, but renders the current moving through it the same as when *b* is in its place. When this is done the effect of the earth's magnetism is to cause a slight deflection of the suspended coil from its position of rest, to which it is then re-adjusted by turning the torsion-head.

So far I have found this method to be convenient, although the apparatus I use is home-made, it has the advantage of being strictly a zero method, and the instrument is not encumbered with any table for the reduction of observations.

III. THE POTENTIAL DYNAMOMETER AND RESISTANCE MEASURER COMBINED.

This instrument is designed to fulfil a double duty, and as a potential dynamometer is equally available for continuous and for alternate currents.

It consists of two circular coils of moderately fine copper wire, one of which is held by a bifilar wire suspension inside the other, as in Weber's well-known dynamometer. When required, however, to be used as a galvanometer, the suspended coil can be readily removed and replaced by a magnet needle.

When used as a dynamometer with a potential-difference of one Daniell between the terminals, the suspended coil is deflected to between 100 and 150 divisions of a reflected light point falling upon a scale at a distance of 100 centimetres. This reading, which remains very constant, can, however, be adjusted for a greater or less degree of sensitiveness by altering the distance apart of the bifilar suspending wires.

The reading with one Daniell potential-difference is the constant of the dynamometer, and is obtained by inserting between the terminals a Daniell cell having a resistance sufficiently small that it may be neglected without appreciable error.

When any greater potential-difference is to be measured, an adjustable resistance is inserted in the circuit in order to reduce the current (and deflection) to the same value as the constant. For instance, if a potential-difference, x, of an electric arc is to be measured, the terminals of the lamp, or connections from the carbons, are inserted, with an adjustable resistance which is gradually reduced to r, so as to reproduce the constant deflection of the light-point. The constant current is then represented by two equations:—

$$c = \frac{e}{\rho}$$

ρ being the resistance of the dynamometer wires, and e, volts, the electromotive force of the Daniell, and:—

$$c = \frac{x}{r + \rho},$$

assuming that the resistance of the arc may be neglected, as it is very small in comparison with $r + \rho$.

The electromotive force of the arc is therefore:—

$$x = e\left(\frac{r}{\rho} + 1\right) \text{ volts.}$$

The effect of the earth's magnetism upon the suspended coil is, of course, entirely eliminated, the current being the same in each observation.

The resistance box, which I use in connection with this dynamometer, is constructed with adjustable resistances between one and 100,000 ohms, and has in addition the usual proportion-coils of a Wheatstone bridge.

When it is required to measure the wire resistance of a circuit, this resistance box is employed as a Wheatstone bridge. The suspended coil of the dynamometer is removed, and a magnet-needle inserted in the centre of the stationary coil, so as to readily provide a galvanometer which is sufficiently sensitive for measuring small resistances with the aid of the constant Daniell cell, thus avoiding the necessity of providing separate instruments for this purpose.

IV. THE MEAN PRESSURE-INDICATOR.

The determination of the horse-power performed by the steam-engine is usually made by taking diagrams with a Richard's modification of Watt's indicator. There are, however, some objections to the use of this instrument for this purpose, arising from the necessity of special fittings, besides the fact that these diagrams, obtained at considerable trouble, give more information than is wanted for the object in view.

The horse-power is calculated only from the mean pressure, which I have endeavoured to arrive at in a more simple way. Instead of taking indicator-diagrams, I have obtained very good results with a simple Bourdon pressure-gauge, so arranged that the mean pressure at either end of the cylinder can be read off at once, and the horse-power obtained at any moment with very little trouble.

For this purpose I attach to each end of the cylinder a pressure gauge, the pipe leading to which is throttled sufficiently to allow only of a small entry and exit of steam at each stroke. This throttling may be carried to such an extent that the pointer of the gauge rises comparatively slowly to the mean pressure, above and below which it makes small oscillations.

In the arrangement of the gauge, the attachment to the blow-off cock of the cylinder is conveniently made by a short length of thick india-rubber tubing, strengthened by a double serving of tape, and lashed. Between this and the gauge, I insert a tube of brass containing, in a socket coupling, a screw plug, through which a small hole is bored. Every precaution has, of course, to be taken to prevent condensation of steam in the throttle or in its immediate neighbourhood. For this purpose I keep the throttle-tube at a temperature considerably above the temperature of the steam by placing the flame of a lamp underneath it. Between the throttle and the pressure gauge is a small blow-off cock. Before observing the mean pressure this cock is opened, and steam blown through. It is then closed, and the pointer of the gauge rises by a series of jerks up to the mean pressure, about which it oscillates through a small arc, the mean point being easily observed.

ON A NEW ARC ELECTRIC LAMP.

By W. H. PREECE, F.R.S.

[Read before Section G of British Association.]

ELECTRIC lamps on the arc principle are as numerous as the trees in the forest and it is somewhat fresh to come upon something that is novel. In these lamps the carbons are consumed as the current flows, and it is the variation in that consumption which occasions the flickering and irregularity of the light that is so irritating to the eyes. Special mechanical contrivances or regulators have to be used to com-

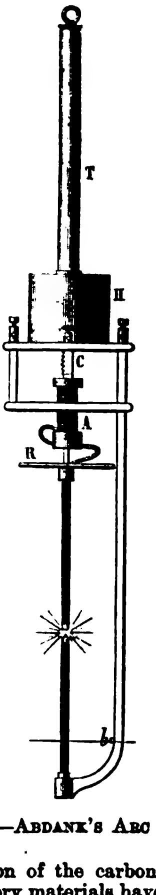


FIG. 1.—ABDANK'S ARC LAMP.

pensate for this destruction of the carbons, as in the Siemens and Brush type, or else refractory materials have to be combined with the carbons, as in the Jablochkoff candle and in the Lampe-Soleil. The steadiness of the light depends upon the regularity with which the carbons are moved towards each other as they are consumed, so as to maintain the electric resistance a constant quantity. Each lamp must have a certain elasticity of regulation of its own to prevent

irregularities from the variable materials of carbon used, and from variations in the current itself and in the machinery.

In all the electric lamps, except the Brockie, the regulator is in the lamp itself. In the Brockie system the regulation is automatic, and is made at certain rapid intervals by the motor engine. This causes a periodic blinking that is detrimental to this lamp for internal illumination.

M. Abdank, the inventor of the system which I have the pleasure of bringing before the Section, separates his regulator from his lamp. The regulator may be fixed anywhere within easy inspection and manipulation, and away from disturbing influence in the lamp. The lamp can be fixed in any inaccessible place.

The Lamp (figs. 1, 2, 3).

The bottom or negative carbon is fixed, but the top or positive carbon is movable in a vertical line. It is screwed at the point, C, to a brass rod, T (fig. 2), which moves freely inside the tubular core of

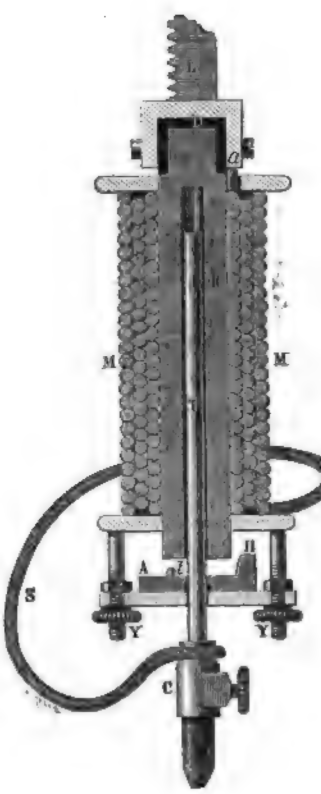


FIG. 2.—ABDANK'S ARC LAMP.

an electro-magnet, E. This rod is clutched and lifted by the soft iron armature, A, B, when a current passes through the coil, M, M. The mass of the iron in the armature is distributed so that the greater portion is at one end, B, much nearer the pole than the other end, hence this portion is attracted first, the armature assumes an inclined position maintained by a brass button, *t*, which prevents any adhesion between the armature and the core of the electro-magnet. The electric connection between the carbon and the coil of the electro-magnet is maintained by the flexible wire, S.

The electro-magnet, A (fig. 1), is fixed to a long and heavy rack, C, which falls by its own weight and by the weight of the electro-magnet and carbon fixed to it. The length of the rack is equal to the length of the two carbons. The fall of the rack is controlled by a friction-brake, B (fig. 3), which acts upon the last of a train of three wheels

FIG. 3.
SHOWING FRICTION BRAKE.

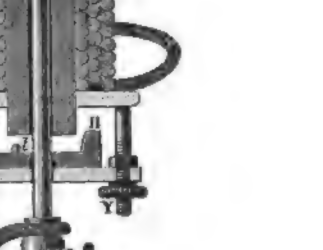


FIG. 5.
LAMPS IN SERIES.

put in motion by the above weight. The brake, B, is fixed at one end of a lever, B A, the other end carrying an easily-adjusted soft iron armature, F, by three screws. This armature is attracted by the electro-magnet, E (whose resistance is 1,200 ohms), whenever a current circulates through it. The length of play is regulated by the screw, V. The spring, L, applies tension to the brake.

The Regulator.

This consists of a balance and cut-off. The balance (figs. 4 and 6) is made with two solenoids, S, S', whose relative distance is adjustable. S conveys the main current, and is wound with thick wire, having practically no resistance, and S' is traversed by a shunt current and is wound with fine wire, having a resistance of 600 ohms. In the axes of these two coils a small and light iron tube (2 mm. diameter and 60 mm. length) freely moves in a vertical line between two guides. When magnetised, it has one pole in the middle and the other at each end. The upward motion is controlled by the spring, N T. This spring rests upon the screw, H, with which it makes contact by platinum electrodes. This contact is broken whenever the little iron rod strikes the spring, N T.

The positive lead from the dynamo is attached to the terminal, B, then passed through the coil, S, to the terminal, B', whence it proceeds to the lamp. The negative lead is attached to terminal, A, and thence to the lamp.

The shunt which passes through the fine coil, S, commences at the

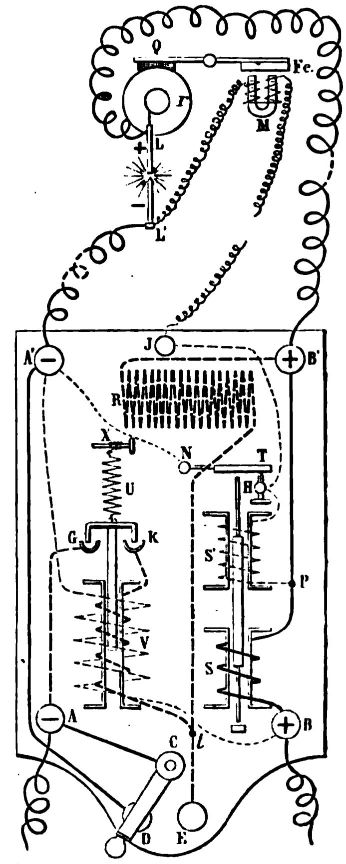


FIG. 4.—ABDANK'S ARC LAMP. THE BALANCE AND CUT-OFF.

point, P; the other end is fixed to the screw, H, whence it has two paths, the one offering no resistance through the spring, T N, to the upper negative terminal, A', the other through the terminal, J, to the electro-magnet of the brake, M, and thence to the negative terminal of the lamp, L'.

The Cut-off.

The last part of the apparatus to be described is the "cut-off," which is used when there are several lamps in series. It is brought into play by the switch, C D, which can be placed at E or D. When it is at E, the negative terminal, A, is in communication with the positive terminal, B, through the resistance, R, which equals the resistance of the lamp, which is therefore out of circuit. When it is at D, the cut-off acts automatically to do the same thing when required. This is done by a solenoid, V, which has two coils: the one of thick wire offering no resistance, and the other of 2,000 ohms resistance. The fine wire connects the terminals, A and B. The solenoid has a movable soft iron core suspended by the spring, U. It has a cross-piece of iron which can dip into two mercury cups, G and K, when the core is sucked into the solenoid. When this is the case, which happens when any accident occurs to the lamp, the terminal, A, is placed in connection with the terminal, B, through the thick wire of V and the resistance, R, in the same way as it was done by the switch, C D.

Electrical arrangement.

The mode in which several lamps are connected up in series is shown by fig. 5. The lead, +, is connected to B of the balance; it then passes to the lamp, L, returning to the balance and then proceeds to each other lamp, returning finally to the negative pole of the machine. When the current enters the balance it passes through the coil, S, magnetising the iron core and drawing it downwards. It then passes to the lamp, L L', through the carbons, then returns to the balance and proceeds back to the negative terminal of the machine. A small portion of the current is shunted off at the point, P, passing through the coil, S', through the contact spring, T N, to the terminal, A', and drawing the iron core in opposition to S. The carbons are in contact, but in passing through the lamp the current magnetises electro-magnet, M (fig. 2), which attracts the armature, A B, that bites

and lifts up the rod, T, with the upper carbon a definite and fixed distance that is easily regulated by the screws, Y Y. The arc, then, is formed, and will continue to burn steadily as long as the current remains constant. But the instant the current falls, due to the increased resistance of the arc, a greater proportion passes through the shunt, S' (fig. 4), increasing its magnetic moment on the iron core, while that of S is diminishing. The result is that a moment arrives when equilibrium is destroyed, the iron rod strikes smartly and sharply upon the spring, N T, contact between T and H is broken, and the current passes through the electro-magnet of the brake in the lamp. The brake is released for an instant, the carbons approach each other, but the same rupture of contact introduces in the shunt a new method of considerable magnitude—viz., 1,200 ohms—that of the electro-magnet of the brake. Then the strength of the shunt diminishes considerably, and the solenoid, G, recovers briskly its drawing power upon the rod and contact is restored. The carbons approach during these periods only about ·01 to ·02 millimetres; if this is not sufficient to restore equilibrium it is repeated continually till equilibrium is obtained; the result is that the carbon is continually falling by a motion invisible to the eye, but sufficient to provide for the consumption of the carbons.

The contact between N T and H is never completely broken; the sparks are very feeble and the contacts do not oxidise. The resistances

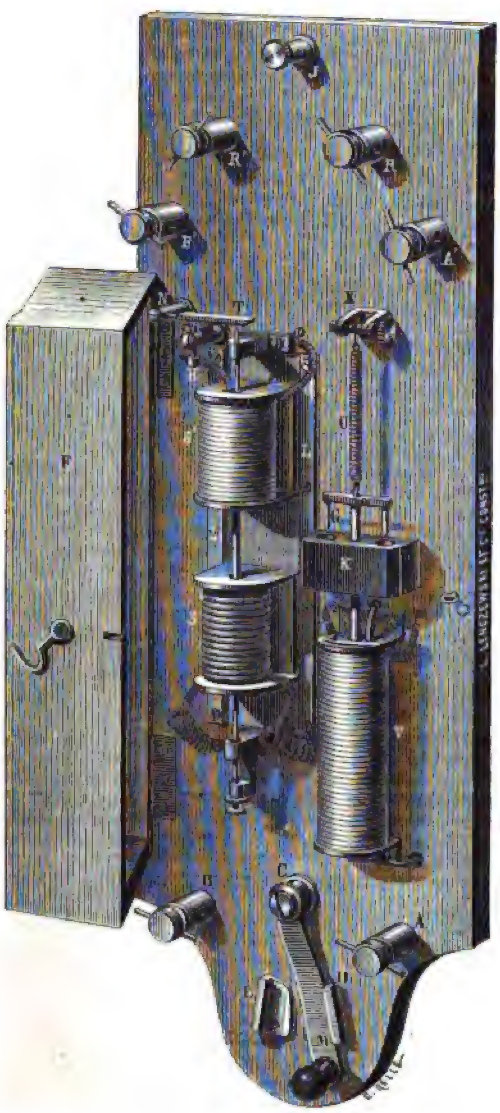


FIG. 6.—ABDANK'S ARC LAMP. PLAN OF BALANCE AND CUT-OFF.

inserted are so considerable that heating cannot occur, while the portion of the current abstracted for the control is so small that it may be neglected. The balance acts precisely like the key of a Morse machine, and the brake precisely like the sounder receiver so well known in telegraphy. It emits the same kind of sound and acts automatically like a skilled and faithful telegraphist. This regulation by very small and short successive steps offers several advantages. 1st. It is imperceptible to the eye. 2nd. It does not affect the main current. 3rd. Any sudden instantaneous variation of the main current does not allow a too near approach of the carbon points.

Let now an accident occur, for instance, a carbon is broken. At once the automatic cut-off acts, the current passes through the resistance, R, instead of passing through the lamp. The current through the fine coil is suddenly increased, the rod is drawn in, contact is made at G and X, and the current is sent through the resistance, R. As soon as contact is again made by the carbons the current in the coil, S, is increased, that in V diminished, and the antagonistic spring, U, breaks the contact at G and X. The rupture of the light is almost invisible, because the relighting is so brisk and sharp. I have seen this lamp in action, and its constancy and steadiness leaves nothing to be desired.

REPORT OF THE COMMITTEE ON ELECTRICAL STANDARDS.

[By LORD RAYLEIGH. At Section A, Tuesday, August 29, 1882.]

IN this matter I am only the mouthpiece of the committee. I have had very little to do with the work of which I am now to give an account. Almost the only matter in which progress has been made has been in experiments upon the effect of annealing upon electrical resistance of various wires of various metals, and in particular upon the temperature co-efficients, *i.e.*, the change which the resistance of the wire undergoes when the temperature is altered. These experiments have led to rather unexpected results, in the direction of showing that these effects are so much greater than is generally supposed, and that therefore there is greater difficulty than is usually thought of in the way of obtaining thoroughly satisfactory resistance standards. The following are some examples of the results obtained. In a wire of German silver, drawn so as to be extremely hard and brittle, the percentage of variation of resistance for one degree was ·0296. After annealing, the percentage of variation for the same wire was ·0421, showing a very large increase. In the case of steel, as might have been expected, the results are even more marked. For a steel wire, thoroughly hardened and tempered in paraffine wax, at a temperature of 230°, the percentage of variation of resistance for one degree was found to be ·267. In the same wire when annealed the percentage variation was found to be ·316. At 9° Centigrade the ratio of the absolute resistance of this wire in the hard state to that of the same wire when annealed, was 1·229. The next result relates to a wire of platinum and silver alloy. A piece of wire from a particular bar of the alloy was hardened by being drawn down through a couple of holes in a draw-plate, and in this state the variation of resistance was ·0255 per cent. per degree. After annealing the variation of resistance was ·0258. The same wire was next placed in an iron tube filled up with sand, and left all night in the fire. After this treatment, the variation of resistance was ·0344. Another specimen of platinum and silver alloy, after being heated to a very high degree and allowed to cool slowly, the variation of resistance was ·095, and the wire was as soft as pure silver and very fragile. When heated to redness and cooled suddenly by the application of water, the variation of resistance was ·076; when the wire was drawn down two or three holes in the draw-plate it was ·073, showing that it had not, even after re-heating, recovered its original condition. This indicates the connection between the temperature co-efficient of wires and the degree of hardness such as to re-open the question as to the nature of a trustworthy material for a proper standard of resistance. The experiments are being continued by Mr. Taylor and Dr. Muirhead. There are one or two points to which I should like to draw the attention of the section in connection with this subject of the comparison of resistance of the standards. At the Cavendish Laboratory at Cambridge, where the original standards constructed by the Committee of this Association are placed, we had no difficulty at all in comparing single units with these standards, which comparison was effected with very great accuracy, the principal source of error being really in determining the actual temperature of the wire at the time of the operation. However, in the case of the platinum and silver standards the sensitiveness to temperature is not very great, and the practical resistance, including the error due to temperature, can be made with the accuracy of one in 10,000 without any difficulty. For practical purposes it is not enough to have certified copies of the unit, but we must have also correct copies of the multiples of the unit, particularly the 10 and the 100. The question arises how these multiples can be best constructed. Hitherto the procedure has been to arrive at the higher multiples by starting with a single unit, making another like it, then joining these and comparing the two with the one, then making another like the two, and so on, and thus build up the standard, say, of ten. But the process requires the aid of several intermediate coils if the object is merely to pass from one to the ten; and these intermediate observations have to be made with the highest accuracy. And, besides, it is a very tedious operation putting the coils together, and requires careful attention to the temperature. My object is to describe a method by which this object of passing from one to ten can be attained, but one more accurate than has been the case in the procedure hitherto. The method turns upon this principle:—I arranged three coils of German silver wire, each to have a resistance of about three units. When these three are placed in multiple arc they formed the resultant, as a single can be compared with the standard single; when, on the other hand, the three are placed in series, of course they have formed an aggregate of nine, which, by the addition of the original standard single, can be brought up to ten. In that way we require rather fewer intermediate coils. But that is not the main advantage. In this process of arcing we do not depend upon the accuracy of the threes which we use in the process. The principle upon which that depends is that if the sum of three resistances be given, then the resistance in multiple arc, when the three are placed in multiple arc, will be the maximum when the three are all equal. And although the three may not be quite rigorously equal, still the resistance in multiple arc is exceedingly near to the truth. All that remains then is to contrive a simple method of making the observations so that the two comparisons can be made to follow one another as quickly as possible. The first comparison consists in putting the three coils in multiple arc, and then comparing them with the standard single; and secondly, putting them in series, and then comparing the ten, or whatever you have arrived at, with the standard ten, which it is the object to test.

There are strips of very long copper plates placed between a planed board. Holes penetrate to the copper plates, and into these mercury is poured. These are the electrodes by which you can make

connection with the instrument. The three holes in which these are arranged are coupled with the single piece of brass tube. The six ends of the coils are connected with these six legs of copper, which project downwards and form the six legs of instrument. Therefore by this means we have the three coils in multiple arc and a resistance nine times less than when combined in series. The next part of the operation consists in displacing the set of three coils laterally, so that from being joined in multiple arc they are now joined in series. The electric current passes to the first cup, then through one of the coils into the lower part of the other, passing along the board to the left hand till it has passed through the whole in series. By this means, then, we have a connection made with the standard single, so that by one simple observation on one multiple arc and a single you can compare the resistance of the three coils with that of the standard single itself. Of course the resistance will not vary much in one experiment. It is therefore of advantage to make the one operation follow the other as quickly as possible, and allow little time for temperature change to enter, and in this way it is extremely easy to compare a 10 or a single with any other auxiliary coils than themselves. It is ready for use at any time. In testing a very rough accuracy is all that is wanted in the component coils. Any error arising from the use of the apparatus would be immaterial. I think the same method might be advantageously used to pass up by hundreds, that is, by using a resistance of 30 instead of a resistance of three, which when put in series will give 90, and then by the addition of the original 10 you will get 100.

APPLICATION OF ELECTRICITY TO THE RAISING OF THE WATER SUPPLY FOR THE TOWN OF LA ROCHELLE.

SINCE 1864 the town of La Rochelle has been supplied by a canal, which conducts the waters from the Lafont spring by an aqueduct into a subterranean reservoir, from whence two vertical balance machines of the Tarcot system, of 15 horse-power each, raise them to the water tower placed upon the culminating point of the town, at a height of about 20 metres. After thirteen years' service the level of the waters has fallen below the bed of the aqueduct supplying the reservoir. It therefore became necessary to hollow out a second gallery at two metres below this bed, and to raise the water from this gallery into the aqueduct leading to the reservoir by means of a rotary pump. This rotary pump is placed at 800 metres from the raising machine, and was actuated by a small separate locomotive, which was very expensive to work, and necessitated the continual presence of two men entirely occupied with this separate machine. Things were thus when M. Groc, Director of the La Rochelle Waterworks, conceived the ingenious idea of utilising the surplus motive force available upon elevating machines for working the rotary pump by means of an electric transmission of power to a distance.

This idea has been realised and the system has been in continual use since the month of July, 1881, without presenting the least difficulty and without interruption.

The transmission is performed by the aid of two Gramme machines with flat inductors of the pattern called "5-lighters." The generator makes 1,300 revolutions, the receiver about 800. This speed varies, moreover, a little with the level of the water in the lower gallery, a level which varies the work produced by the pump.

The line which connects the two machines is aerial; it is supported upon telegraph poles, and is 800 metres long. It forms a complete closed circuit. Each of the conductors is composed of two iron wires, of six millimetres diameter, fixed upon porcelain insulators, connected at intervals by transverse wires. The result is that if one of the wires is broken at any point whatever, the whole current only traverses the remaining wire over a length equal to the distance which separates two transverse joints of the double wire, the increase of resistance which ensues is then very small, and practically insensible. The line is represented by a double wire of six millimetres diameter ($\frac{1}{4}$ inch), and 1,600 metres long. Its resistance is about 3·5 ohms.

The work produced by the pump, in raising water, is equal to 140 cubic metres per hour raised to a height of two metres, that is to say, a little more than one horse-power. The force actually transmitted is about two horse-power. The work of the rotary pump in raising water is equal to one-tenth of that produced by the raising machines; the expenditure of steam is increased about one-sixth by the putting in action of the rotary pump. This is an insignificant expenditure in consideration of the special conditions of the installation. One workman only is required, placed near the pump, to oil the dynamo-electric machine and the pump. It will even be possible to dispense with him by providing the apparatus with oiling mechanism of sufficient capacity. One visit each day before the setting in motion will then make sure of the operation of the system without special supervision.

The motion of the pump is given by friction; to this end the dynamo-electric machine oscillates around a horizontal axis parallel to its own, placed at the lower part of the building. Its axle bears two pulleys, the rims of which are covered with leather, placed opposite two pulleys of a larger diameter placed upon a fixed arbor. By means of a manipulating lever, the axle of the machine is drawn towards or away from the fixed axle which controls the rotary pump by means of a transmission by pulleys and belts. The pressure of the friction pulleys is regulated by means of a manipulating lever kept in its place by a screw.

To put it in motion and also stop it, we begin by drawing away the transmitting motor, in such a manner that it turns freely.

Thus any extra current at the moment of stoppage when the circuit is interrupted is avoided, and any sudden shock at the moment of setting in motion. This is a most interesting and most suitable application of the transmission of power to a distance. No means of transmission at present known would have solved the problem with so much simplicity and elegance. We are glad to call attention to such applications, for they show much better than all the theories in the world, what powerful resources electricity offers to us when we know how to make judicious use of it.

NEW PROCESS FOR THE RAPID FORMATION OF SECONDARY COUPLES WITH PLATES OF LEAD.

WE know that the method employed for a long time by M. Planté for forming accumulators consisted of a sort of electro-chemical tanning of the plates produced by the passage of the current into the couple several times in reversed directions, taking care to allow intervals of repose between each change of direction.

This method gives layers of peroxide of lead and of lead reduced to a crystalline state adhering perfectly to the remainder of the plate which is not attacked, but it requires a tolerably long time, especially at the commencement.

To facilitate the attacking of the lead by the action of the primary current, and to accelerate the formation, M. Planté has made experiments and discovered that good results can be obtained by raising the temperature of the liquid containing the secondary couples, sometimes beforehand, sometimes during the action of the current.

The employment of heat presents, however, some difficulties in practice. M. Planté has had recourse in this case to another process, which has given him very satisfactory results, and which he has communicated to the Académie des Sciences of Paris at its sitting on the 28th August last.

This process consists of simply submitting the secondary couples to a sort of thorough scraping by means of nitric acid diluted with half its volume of water, and leaving them immersed in this liquid during 24 or 48 hours. The couples are then emptied, washed very thoroughly, refilled with water acidulated with 1-10th of sulphuric acid, and submitted to the action of the primary current. This prolonged immersion in diluted nitric acid produces the dissolution of a portion of the lead plates, but their thickness is not sensibly diminished by it. The metallic porosity produced by the nitric acid causes the ulterior electro-chemical action of the current to be exercised not only on the surface of the plates, but also on their interior; it creates new molecular intervals, and consequently facilitates the formation of the plates, considerably shortening its duration. In fact, the secondary couples thus treated can furnish, after three or four changes in the direction of the primary current, discharges of long duration, whilst, without the previous action of the nitric acid, it could only give the same results after several months' formation.

Accumulators prepared by this method seem, therefore, to present at once the advantages of couples of lead plates; that is to say, a good adherence of the deposits and the absence of the felt which maintains the minium upon the plates of the Faure couples, and at the same time the advantage peculiar hitherto to the Faure couples; that is to say, a rapid formation—a condition indispensable with accumulators intended for industrial application. It would be interesting to make new and careful comparisons between the last models of M. Faure and the new apparatus of rapid formation of M. Planté, as much from the point of view of rapidity of formation as of capacity of storage and of their effective duration in continual service.

ASSOCIATION FRANÇAISE POUR L'AVANCEMENT DES SCIENCES.

(From our own Correspondent.)

MEETING AT LA ROCHELLE.

PHYSICAL SECTION.

SITTING OF THE 28TH AUGUST, 1882—*(continued)*.

APPARATUS FOR OBSERVING THE DIRECTION AND RAPIDITY OF LIQUID CURRENTS AND PARTICULARLY OF MARINE CURRENTS.

By M. BONNEAU.

THE apparatus presented by the author to the Association Française is an improvement on that which was shown at the electrical exhibition at Paris. M. Bonneau has added to it a registering system which will enable the variations in speed and direction of marine currents to be followed continuously. We shall shortly have occasion to describe it with the assistance of figures.

ON THE DISTRIBUTION OF ELECTRICITY.

By M. DEBRUN, Professor of Physics at the Lycée of Pau.

The system proposed by M. Debrun consists in inserting a[illegible]mulators between the producer and consumer to prov[illegible] accidental stoppage of the machine. The distribution mus[illegible] out under constant pressure, the accumulators disposed i[illegible] branch of the circuit of distribution. The branch does not rece[illegible] the current

directly from the main channels of distribution, but from the accumulators always in communication with the main circuit, except in cases when, by accident, the production ceases for a given time; an automatic interrupter then separates the accumulators from the main circuit, and these continue to supply the consuming apparatus, lamps, motors, &c.

The electricity is measured by passing a derivation of the current into an electrolytic vat containing cyanide of silver, and by weighing the silver deposited at the end of a given time.

To maintain a constant distribution pressure, the needle of a fine wire galvanometer, placed in communication with the terminals of the machine, closes the circuit upon two bells of a different pitch, according as the electromotive force is greater or less than its normal value. The attendant thus warned can then restore things to the normal state by altering the speed of the machines or their excitation.

NEW SYSTEM OF ELECTRIC GENERATING APPARATUS.

By Dr. BRARD, of La Rochelle.

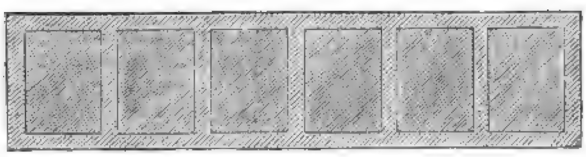
The object which M. Brard has in view in his researches is to produce an apparatus capable of transforming heat into electricity without having recourse to the complications presented by dynamo-electric machines which have been hitherto inapplicable for domestic illumination; M. Brard wishes to produce a veritable electro-generative stove, furnishing at the same time heat, light, and electricity. After having demonstrated by his experiment that thermo-electric batteries have on one hand only a feeble production, and on the other hand are soon rendered useless under the action of heat, M. Brard thinks he has found the solution of the difficulty in a thermo-chemical battery, in which the current is produced by chemical action, the combustion of carbon, under the influence of an elevated temperature produced by a special method, by the oxidising action of nitrate of potash or soda. It forms thus a veritable thermo-chemical battery, analogous to the ordinary batteries in which the oxidising of the carbon takes the place of the oxidising of the zinc and the nitrate of potash of the oxidising body. The carbon is, therefore, the negative pole, and the nitrate the positive pole of the element.

M. Brard alluded, in reference to his labours, to the experiments of Antoine-César Becquerel in 1855, and those more recently made by M. Paul Jablochkoff in 1877; he has, however, gone further than his antecedents in this way, for he has presented to the association the principal features of an apparatus actually in construction, and showed some electro-generative slabs which we are about to describe, reserving the description of the complete generator until it has been tried, and until it has undergone certain modifications which the experiments will suggest.

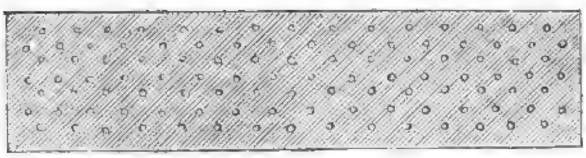
Electro-generative Slab.—The electro-generative slab may be defined as *a piece of prepared carbon which, when thrown into the fire, produces electricity by its combustion.* The subjoined figures which represent the exterior view of it, the longitudinal section and the transverse section, will demonstrate clearly the principle of it.

The slab presents the external appearance of a parallelopiped, about 15 centimetres (6 inches) long, 3½ centimetres (2 1-6th inches) wide, and 25 millimetres (1 inch) thick; the materials which compose it are enveloped in a sheet of asbestos paper, only two thin sheets of brass being exposed to view, which serve as conductors of the current. The interior consists theoretrically of a prism of carbon and a prism of nitrate of potash, separated by a plate of asbestos, which plays very nearly the same part as the porous cell in ordinary batteries. In practice the sheet of carbon is formed of about 100 grammes of coal-dust, formed into a paste with molasses or tar. The paste thus obtained is strongly compressed, cold or preferably with heat, in a mould of suitable form, at the bottom of which has been placed previously a sheet of copper, of brass, or any other metal which is a good conductor, cut into several strips, which are found embedded in the agglomeration of the carbon and project from one of its extremities to constitute the negative pole. The mould is disposed in such a manner that the slab is perforated throughout its thickness with numerous holes intended to facilitate combustion and to multiply the points of contact of the carbon with the nitrate, as we shall presently see. It bears besides upon the upper surface rectangular depressions 15 millimetres deep divided by transversal partitions more or less numerous, obtained by the moulding. The angles thus formed are intended to prevent the flowing of the melted nitrate into the fire during the working of the apparatus. The whole surface of these compartments is covered by a thin sheet of asbestos paper. The upper part of the brick is formed of a mixture of three parts of ashes and one part of nitrate of soda or potash. The ashes are intended to prevent a too rapid combustion, and to prevent the slab from melting. This mixture is melted and poured upon the brick very hot and in a syrupy state. About 100 grammes per slab are required, equal to about 25 grammes of nitrate and 75 grammes of ashes. A second sheet of copper or brass analogous to the first is embedded in the nitrate before cooling, and forms the second pole of the slab. The whole is enveloped in a sheet of asbestos paper.

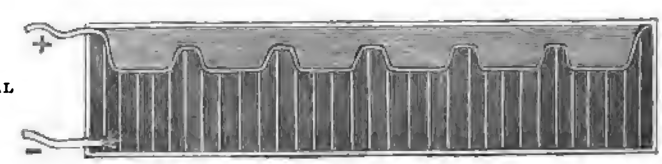
It is sufficient to place in a fierce fire the extremity of the slab opposite to the conductors, in order to obtain in a few minutes a continuous current—and a constant one if the slab is homogeneous—during its combustion, lasting an hour and a half to two hours. M. Brard has not yet taken the constants of this new thermo-chemical battery, but in an experiment which we owe to the chemical department of the laboratory of the Lycée of La Rochelle, a single slab was sufficient to actuate an electric bell of the ordinary commercial form.



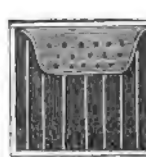
TOP VIEW.



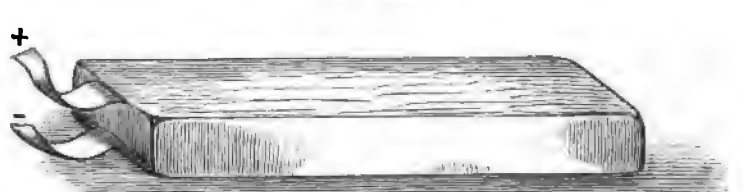
UNDERNEATH VIEW.



LONGITUDINAL SECTION.



TRANSVERSE SECTION.



GENERAL VIEW OF SLAB.

One can, moreover, burn several briquettes at once, and group them in tension or in quantity to increase the effect. Three or four slabs in tension produce the decomposition of water.

Such are the results at present obtained by M. Brard. Without expressing an opinion as to the future and the results which will be obtained from this apparatus, which is at present confined to the laboratory, we may observe that these researches are very interesting, and that to M. Brard must be ascribed the honour of having been the first to construct a veritable *electro-generative combustible*.

ELECTRO-CHEMICAL METHOD OF DETERMINATION OF EQUIPOTENTIAL LINES UPON PLANE SURFACES.

By M. Adrien Guébhard.

The remarkable works of the author are of a too theoretical nature, to our great regret, to allow us to submit them here to an analysis which would necessarily be succinct, and consequently incomplete. These works have, moreover, been published at various times in the *Comptes Rendus* of the Académie des Sciences, 1881-1882. We refer our readers to them.

The programme of the Physical Section included, besides the communications which we have just reviewed, certain others which were not read owing to the absence of the writers. The Physical Section having thus practically exhausted its programme separated, electing as President of the Section for the next year M. Bertin, subdirector of the Ecole Normale Supérieure, of Paris, and as delegates, MM. Alfred Niaudet and Edouard Hospitalier.

The La Rochelle meeting closed on August 31st. The twelfth session will be held one month, from August, 1883, at Rouen (Lower Seine).

Conferences.—During the Congress two public conferences have taken place, one on the deep water harbour of La Rochelle, by M. Bouquet de la Geye, the other on the electric light, by M. Hospitalier. This conference, without any scientific pretensions, held with the object of popularising the subject, presented one peculiarly interesting point: all the electric light experiments were made by the aid of thirty Faure accumulators, charged at Paris on Sunday, sent express to La Rochelle, and employed on Wednesday evening for the conference without having sensibly lost their charge. They were used to work arc lamps, a Jablochkoff candle, a Reynier lamp, and the incandescent lamps of Edison, Swan, and Maxim. After the conference they still contained sufficient electricity to operate a Mangin projector of 200 burners. The total energy stored up represented nearly one horse-power during eight hours.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

ECONOMICAL ELECTRIC LIGHTING ON A SMALL SCALE.

To the Editors of The Electrical Review.

Sirs,—In South Africa we are debarred from the many advantages enjoyed by young men in England for experimenting, and the amateur scientist of limited income here gets confused and sceptical when comparing the knowledge he attains by studying the various text-books by eminent men on electrical science with those applications of the science for really useful purposes.

Men who live wholly upon the plane of science describe their and others' discoveries and inventions in such a positive and eloquent style that begets faith in the minds of those dwelling upon the lower plane of commerce and practical application, who watch with hunger and patience for the crumbs, &c. But it so frequently happens that what is published from the master's plane as a valuable practical application of a law of force is, when viewed by those who have anxiously awaited its development, a mere toy, or a piece of mechanism too delicate for hands other than those of pure scientists. Thus the outsider is deluded by the pictures descriptive of important discoveries; for he finds that when brought down upon the plane of useful application the atmosphere is too dense and they cease to exist.

I trust you will accept this as a sufficient excuse for requesting information of a useful nature upon the subject of lighting by electricity on a small scale.

Dynamo-electric machines are by far too expensive, cumbersome, and unmanageable for use in private houses. Voltaic batteries, although much cheaper (that is, involving less outlay) and more manageable, are still very troublesome when compared with the use performed.

In this country paraffine oil is the chief source of artificial lighting. What is required to supersede that method *partially*, for purposes requiring a better light, is an easily manageable, and not costly, means of applying electricity; something which would effectually replace the bulk of a battery—reduce a battery to a few cells—would accomplish what is needed. There are many who would not object to a reasonable amount of trouble to secure the advantage of a superior light. Now, a good deal is said in text-books on electrical science about the great power of "current induction coils"—that the current from a few cells of a suitable battery produces powerful effects when passed through an induction coil of even small dimensions. Dr. Ferguson writes:—"Of late years coils of great power have been constructed, *rivalling, if not exceeding, the most powerful electric machines* in length and power of spark." Yet little or nothing is said at the present time about their application to electric lighting in households. Mr. J. W. Urquhart, C.E., in his work on the "Electric Light; its Production and Use, &c.," merely mentions that some generators have been constructed upon the principle of current induction, and says they are not the most successful, and passes the subject by. This would make induction coils, from a practical standpoint, appear of no value, in spite of the fact that every scientific writer on electricity speaks so very highly of them.

Your valuable journal seems to be the only source of thorough information on these matters—so highly desirable in the interests of this rapidly developing science as a guide to the sanguine uninitiated—and I shall be glad to know if it is economical to use induction coils in place of large batteries for the production of a light for everyday use. Is the light steady produced through this medium? If not, can a small secondary battery be used between the induction coils and the lamp with the effect of steadying the light? If so, whose make is the best for real use? Can more than one lamp be used in the circuit, either in series or multiple arc? Any information of a practical nature will be esteemed.

NATALIAN.

July 21st, 1882.

[We will endeavour to answer our correspondent's letter fully in our next issue.—Eds. Elec. Rev.]

RECENT PROGRESS IN TELEPHONY.

To the Editors of The Electrical Review.

Sirs,—On reading the paper, in last Electrical Review, as read by Mr. W. H. Preece, on "Recent Progress in Telephony," before the British Association, I was struck with the similarity of an experiment, and even the use of the very words, as was done and used by an old friend of mine thirty years ago. The words I refer to are put in italics in your report, and are "*to communicate across seas and channels without the aid of wires at all.*" This individual was a Mr. J. B. Lindsay, of Dundee, a man who was evidently born fifty years too soon; devoted a great portion of his time to electric lighting and telegraphy; demonstrated the practical possibility of sending needle deflections across large bodies of water, across the docks at Dundee in 1848, and 1850, across the Tay at Perth and the Dee at Aberdeen. In 1859, at the latter, city Mr. Lindsay endeavoured to demonstrate his system before the British Association then assembled there, but was barely listened to, and laughed at as a visionary.

With your permission I will be glad to give more about this uncommon man's many electrical ideas—ideas which have since become realities.

I am, &c.,

G. LOWDON,
Electrician.

Dundee, *September 4th*.

[We shall be glad to receive any further communication on these matters from Mr. Lowdon, if authentic.—Eds. Elec. Rev.]

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I was not so far wrong, it seems, when I remarked that "Justice" had more of *law* than of justice in his composition: for what I suspected he now admits, namely, that his letter was based not on the real justice of the question, but upon a Chancery judge's decision—which may or may not be accepted as final, and which proves nothing on the abstract point, because it does not follow as a necessary truth either that the proper evidence was placed before the court, or that the court was able to appreciate questions of electrical science. As to the "blissful ignorance" of Sir Frederick Bramwell on matters electrical, I decline to enter upon such a personal topic. But as your correspondent, "Justice," cites the judgment of Mr. Justice Fry, I have consulted a copy of that document, and I find that the learned judge lays down with great clearness and discrimination that the class of tension-regulators which Edison's claim is held to cover (in combination with a diaphragm), is a class in which the tension-regulator is made of a substance that is compressible, semi-conductive, and resilient. The judge adds, "I think, therefore, that the true meaning of the claim which I have just read, is the union of a tympan or diaphragm capable of vibrating under the sound-waves with an electric tension-regulator *having the quality* which I have just described." (I italicise the words which "Justice" has overlooked.)

Further, I am compelled to differ absolutely from "Justice" on a point of the very gravest moment.

"Justice" says: "I now merely recite the words of the decision of Mr. Justice Fry, who did not think it had been established '*that Reis's transmitter combined a diaphragm with a tension-regulator.*'" I italicise the words which "Justice" says he "merely recites" from the decision, and which "Justice" puts into quotation marks. Now I have gone carefully through the twenty-seven pages of the printed judgment delivered by Mr. Justice Fry, with the remarkable result of finding that the words which "Justice" says he "merely recites," are not to be found therein at all from the first page to the last. Mr. Justice Fry in his decision does not use those words nor anything approaching them. On the contrary, he says (see printed Judgment, p. 11, line 32): "*Such a tension-regulator as Mr. Edison invented has been discovered in Reis's instrument.*" I, therefore, deliberately accuse "Justice" of a contemptible and disgraceful literary fraud in attempting to palm off as a quotation from Mr. Justice Fry's very clear decision, words which not only are contrary to the sense of that decision, but which are not even to be found there at all.

I must absolutely and peremptorily decline to say one word more in reply to a writer who can thus abuse the name of "Justice," in order to perpetrate so palpable and monstrous an INJUSTICE.

ELECTRIC LIGHTING CONTRACTS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I have much pleasure in replying to Mr. Hammond's letter. My object in writing you was merely to contradict a statement which, unless explained away, might have had a detrimental bearing on the Pilsen Company. Mr. Hammond's explanation is in every way satisfactory, and I regret that he should consider that any imputation was made by me, and assure him it was not intentional.

I remain, Yours faithfully,

JAMES BEATTIE.

6th September, 1882.

MANGANESE.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Will you kindly, through the medium of your columns, give me some information about Manganese. We have several mines of it in this district lying idle. A trial shipment was sent to London (some 50 tons) a few months back, but no returns are yet to hand. I should like to know something of the different kinds that are at present in demand, and of the mode of reducing the ore. If I am asking for more information than you can afford to give in your columns, would you kindly let me know in what works I could obtain it. AN OLD SUBSCRIBER.

Port Curtis, Queensland, *8th July*.

[Owing to the pressure on our space we are this week obliged to leave over answers to correspondents. In the meantime perhaps some of our readers may have such information at hand as "An Old Subscriber" desires.—EDS. ELEC. REV.]

NOTES.

ELECTRICAL REVIEW.—REMOVAL OF OFFICES.—On and after this date the REVIEW will be published at 22, Paternoster Row, to which address letters for the "Editors" may be sent. Business communications to be addressed to H. Alabaster, to whom cheques and post-office orders (on chief office, London) should be made payable.

THE DOMINION TELEGRAPH AND SIGNAL SERVICE.—We make the following extract from the *Dominion Annual Register*, 1881:—"A telegraphic and signal service has been established at Ottawa as a regular branch of the Public Works Department, under the management of the well-known engineer and electrician, Mr. F. N. Gisborne, the original projector of the Atlantic cable. His appointment by the Government of Canada dates from 1st May, 1879."

The following is a brief summary of important services performed under Mr. Gisborne's management:—"The construction of the coast telegraph line between Canse and Halifax, Nova Scotia, under contract with the Dominion Telegraph Company; the inspection and reorganisation of the telegraph service in British Columbia, and subsequent purchase from the Western Union Telegraph Company of all their lines and cables within the province, whereby the saving of a large annual expenditure was effected; the fitting out, under contract with the India-rubber, Gutta-percha, and Telegraph Works Company, of London, England, of the Government steamer *Newfield* as a cable ship, and the subsequent laying of the following submarine electric cables: Anticosti Island to Gaspe, Province of Quebec; Magdalen Islands to Cape Breton, Nova Scotia; Bras d'Or, Lake Crossing; Grand Manan to Campo Bello, New Brunswick; and Campo Bello to Eastport, State of Maine; all of which are in successful and economical operation. The construction under contract with Messrs. Kennedy, Bertrand and Co., of the land lines upon Anticosti, and the Magdalens, in connection with the Hon. P. Fortin's comprehensive plan for establishing signalling stations and fishery bulletins throughout the Gulf of St. Lawrence and shores of the Dominion; the construction under contract with Messrs. Robinson and Co., of the land lines upon Grand Manan and Campo Bello Islands; the erection, under agreement with the Dominion Telegraph Company, of a land line between Bay St. Lawrence and Sydney, Cape Breton, Nova Scotia. The submergence, under Mr. Gisborne's supervision, of the following electric cables: Saanich Arm-Nanaimo to Gabriola, Vancouver Island; Valdes Island to Point Gray, British Columbia; also the raising and repair of six old cables upon the San Juan Island route; the construction (now in progress) under contract with the Montreal Telegraphy Company, of land lines between Baie St. Paul and Chicontimi, and Murray Bay, towards Point des Montes."

It will be seen from the above that Mr. Gisborne's services have been of a most valuable character, and are held in high appreciation, not only by the Government, but by the people and press of the country generally.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY'S CABLE SHIPS.—The *Panama Star and Herald* of the 10th ult. gives the following information as regards the movements of the repairing vessels of the West India and Panama Telegraph Company:—St. Thomas, August 4th.—The cable ship, *Duchess of Marlborough*, returned here yesterday from Grenada, having repaired the section between that island and Trinidad. The cable steamer, *Grappler*,

also returned to harbour for a supply of steel wire grappling rope, which was quickly transferred from the *Duchess*, and the latter having coaled, both steamers left early this morning to effect the repairs of the St. Thomas and St. Kitts section. The *Grappler* has already been occupied on this nearly five months, during which time she lost several thousand fathoms of valuable steel grappling rope, grapnels, and buoys. She is now working in over one and a half miles of water. This great depth, and the irregular and rocky nature of the bottom, are retarding operations. The weather lately has been rough, and has washed the buoys off the cable when, with calm weather, it would only have been a matter of a few hours to complete the work. This cable when repaired will be practically a new one. The whole of the line from St. Kitts to within about twenty miles of St. Thomas having been submerged during the last twelve months.

AUTOMATIC ELECTRIC SIGNALLING ON RAILWAYS.—An evening paper, prone to indiscreet dabbling in scientific matters, says that "a tolerably complete scheme of the kind was invented and patented several years ago by Sir David Salomons, and it has been re-invented and patented two or three times since." The fact is Sir D. Salomon's invention was not patented till October 13th, 1874 (No. 3,515), whilst a similar device had been invented and patented by Mr. W. T. Whiteman as early as January 22nd, 1874 (No. 270).

ELECTRIC RAILWAY IN SWITZERLAND.—From Switzerland it is reported that an arrangement has just been concluded by Mr. Pearson, of the London firm of John Taylor and Co., on behalf of a syndicate of English capitalists, and Mr. Theodore Turrettini, acting for the local government, for the construction, on the Edison system, of an electric railway from St. Julien, in Savoy, to Ferney, and thence to Geneva. The total length of the line will be about 16 miles.

THE GERMAN RAILWAY ACCIDENT.—The telegrams from the continent agree that the appalling railway accident which happened near Hugstettin on Sunday last, when upwards of fifty persons were killed and numbers injured, was caused by a telegraph pole having been thrown across the line during a thunderstorm. As we may shortly expect stormy weather, it is, perhaps, not too much to ask the railway companies to cause their lines to be carefully examined, so that a similar catastrophe in our own country may not be chronicled.

THE TELEGRAPH ARRANGEMENTS OF THE ARMY.—The telegraph arrangements of the army in Egypt are ordered to be under the commanding officer of the Royal Engineers, and to be divided into two portions—that in front of the advanced depôt, and that between the advanced depôt and the base of operations. Arrangements have been made for detachments of soldiers to patrol all the telegraph lines to prevent the wires being cut or tapped by the enemy, and for military guards to protect the telegraph stations. Stores have been sent out for 12 stations. In addition to the necessary telegraph waggons and reels, there have been sent 24 "sounder" instruments for the dozen stations, and 15 Morse recording instruments for field work, together with 360 rolls of Morse paper, 48 Leclanché 10-cell batteries, 500 insulators, 200 iron telescopic telegraph poles, a large number of wood poles, 12 lightning protectors, 12 wheels for cipher signalling, 1,200 yards of copper wire covered with gutta-percha, 36 miles of insulated copper wire, and 36 miles of insulated galvanised iron wire. In addition to the above, the Royal Engineers have taken out an assortment of stores for army signalling, *i.e.*, effecting communication by means of visual signals between different posts in forts and military stations. Among these are 36 hand-draw telescopes for field observations, 72 gas-bags, and 36 pressure-bags for the lime light for night signalling, 36 lime light lamps, 72 large powerful bull's-eye signalling lamps, 36 heliographs, 36 fog-horns, and 72 army signalling flags and poles. Altogether, the telegraphic and signalling arrangements of the campaign are said to be the most of those of any army which ever took the field.

TELEPHONING EXTRAORDINARY.—According to the Bradford *Daily Chronicle*, a well-known reciter gave "As you like it," the other evening, in the Technical School. The Telephone Company, which has subscribers in Halifax, Leeds, Dewsbury, and Huddersfield, supplied them with a treat, for there were placed on a table on the platform several different kinds of transmitters, thus enabling all their subscribers, who were miles away, to hear the recitation. The subscribers at Leeds, during the evening, notified that in addition to hearing the elocutionist, at the finish of each act the applause of the audience was quite audible. Each evening, when a performance takes place in the hall, it is to be heard at the various towns where subscribers reside. At one of the chapels in Halifax the telephone is fixed to the head office at Bradford, and it is said that each Sunday the service is heard in Bradford.

THE TELEPHONE CABLE ACROSS THE TAY.—On Monday the Dundee Harbour Trustees considered the application of Mr. Young, District Engineer of the National Telephone Company, Limited, for permission to lay a telephone cable near to the Post-office cables at West Ferry, for the purpose of connecting Dundee to Fifeshire. The meeting resolved that the Harbour Trustees, in so far as they are interested, assent to the laying of the cable by the aforesaid company at the place referred to, on the company obtaining the consent of the Board of Trade to the proposed operation.

THE FRENCH ATLANTIC CABLE.—We observe that the steamer *Scotia*, Captain Cato, belonging to the Telegraph Construction and Maintenance Department, left Plymouth on Saturday, to renew her efforts at repairing the French Atlantic cable. This, after being repaired a thousand miles from Plymouth, again parted within 20 miles of the original breakage. The *Scotia* has taken coal and provisions for two months.

QUICK RETURNS.—The Eastern Telegraph Company are said to be realising by the war in Egypt a daily revenue of £6,000. This income is derived exclusively from the despatches—official and press—sent from the headquarters of the army on the Canal and from Alexandria. Until the outbreak of the war there was no direct telegraphic communication between Port Said and Alexandria. The Eastern Company laid a cable from Alexandria to Port Said, at a cost of £24,000 and this sum was paid off by the revenue of four days.

ELECTRIC LIGHTING AT EASTBOURNE.—The Local Board of Eastbourne having entered into a contract for the lighting of the principal thoroughfares by electricity, on Friday the 1st inst. the Parade was illuminated by 16 Brush lights. Other lamps are soon to be in operation, the dynamo-electric machine employed being capable of producing 40 lights. Of the present installation the last lamp is at a distance of two miles from the station, and a length of cable amounting to four and a half miles is used, laid underground.

ELECTRIC LIGHTING.—At a meeting of the Aberdeen Town Council, held on Monday last, the Gas and Lighting Committee reported that, having considered the remit made to them with reference to the bill promoted by the Corporation in relation to the supply of light by electricity, they were of opinion that no action under the statute should be taken at present. This recommendation was adopted. The Lord Provost said their gas engineer might be instructed to make some experiments in electric lighting which would be productive of considerable interest to the city. He hoped the committee, in making up the gas estimates for the year, might be able to consider whether they would not set aside £200 or £300 in order that the engineer might have an opportunity at some suitable place to make experiments on behalf of the city.

A letter from the managing director of the Brush Electric Light and Power Generator Company, asking the Edinburgh Town Council to make a trial of their light on Waverley Bridge and North Bridge, engaged the attention of the Cleaning and Lighting Committee on Monday. While there is an evident chariness to further experiment with the electric light, the fact that while Princes Street is fairly well

lighted by Bray's gas burners, it is at a cost greater than the electric light; that the terms now proposed are more favourable than those concluded last year, and that the North British Railway Company, instead of giving it up, are extending its use, will not be without their influence on the decision of the sub-committee, to whom the question has been entrusted.

THE ELECTRIC LIGHT IN ST. LUKE'S.—The *City Press* says that the vestry of St. Luke's, Old Street, has received a letter from the Metropolitan (Brush) Electric Light and Power Company (Limited) asking the consent of the vestry to the grant by the Board of Trade of a licence, under the Electric Lighting Act of last session, for the supply of electricity within the parish, to be taken into consideration at the next meeting of the vestry.

ELECTRICAL ENGINEERING.—The Hammond Company Electrical Engineering College at 2, Red Lion Square, was opened last Wednesday for its first session, after an introductory speech by Mr. Robert Hammond. We hear that the College starts with 25 pupils. Mr. H. E. Harrison, B.Sc., is the Principal.

THE RESISTANCE OF CARBON.—In the course of his paper on "Recent Progress in Telephony," read before the British Association meeting at Southampton, Mr. Preece remarks, when speaking of carbon: "It has the remarkable property of having its resistance lowered when it is heated—the reverse of metals. This observation is due to Mr. Shelford Bidwell." It is rather to be regretted that Mr. Preece did not give the date of Mr. Bidwell's discovery, more especially as Mr. S. A. Varley had entered very fully into this matter in a paper, also read before the British Association, in 1870.

ELECTRICAL APPARATUS.—We have received an illustrated descriptive price-list of apparatus manufactured and supplied by Messrs. H. and E. J. Dale, of Little Britain, London, E.C. The catalogue commences with frictional electricity, and a very complete list of machines and experimental apparatus in connection therewith is given. Magnets and electro-magnets stand next in order, followed by resistance coils, and an exhaustive selection of galvanic batteries and chemicals, some of the more important being of Dale's special construction. The patent "granule" battery is said to give exceedingly good results, four of the large cells keeping a Swan lamp of 5 candle-power in action for forty hours. Telegraphic apparatus, induction coils, telephonic and electric lighting apparatus of all descriptions, together with almost everything appertaining to electrical matters. In fact the catalogue is one of the most complete we have had occasion to peruse, and we can strongly recommend it to all desirous of purchasing electrical apparatus.

ELECTRICITY IN FRENCH LIGHTHOUSES.—A recent law of the French Legislature authorised the application of the electric light in no fewer than 42 important lighthouses on the coasts of France. The total expense of this change is estimated at about £320,000 sterling.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—At 10 o'clock on the morning of the 23rd August, the William Molson Hall, Montreal, was crowded by a brilliant and distinguished audience, to welcome the American Association for the Advancement of Science.

This the 31st annual meeting of the association is one of the most successful yet held; the list of applicants for membership being large, and the papers in the hands of the committee numbering upwards of two hundred. The retiring President, Professor George J. Brush, of New Haven, Connecticut, introduced the new President, Principal J. W. Dawson, F.R.S., F.G.S., &c., who thanked the association for the honour conferred, and said, "I accept it as the choice was in some degree determined by the wish to do honour to Canada, and to give to the meeting a character as thoroughly international as possible. Science from her serene height overlooks all the national boundaries and comprehends the whole world in her scope of vision. It becomes us, therefore, for the time being to merge the character of citizens of the United States of Canada in that of cosmopolitan men of science."

The President stated that the annual meeting of the British Scientific Association opened that day in Southampton, England, and he suggested that a message of greeting be cabled to it from this association, a proposition which met the approval of the meeting.

Dr. T. Sterry Hunt next addressed the association, and after several speeches of a complimentary character, the association divided into nine sections. Section B., Physics, is the only one that calls for notice in these pages. In this section Mr. W. Le Conte Stevens, of New York, read a paper on "Vision by the Light of the Electric Spark."

VISION BY MOMENTARY ILLUMINATION.

This paper was supplemetary to other papers published during the last year, in one of which Mr. Stevens had explained a new method of stereoscopy from a pair of perfectly similar pictures, by so adjusting these in position that the retinal images of them should be dissimilar, and thus the effect of depth in space obtained from the combination. He had explained these geometrically on the assumption that free motion of the eyes was possible in viewing them. The present experiments were conducted to ascertain whether the same effects could be secured when the period of illumination was so brief that no motion of the eyes was possible. Mr. Stevens explained the apparatus employed, which consisted of a reflecting stereoscope, arranged in such manner as enabled the observer to rotate the cards on a vertical axis, and at the same time to secure any desired relation between the visual lines. The electric spark was obtained from a large induction coil, and it was found that in nearly every case binocular effects were perceptible by the light of a single spark. The experiments were varied in many ways and quantitive results were obtained, to which Mr. Stevens referred. He called attention also to a peculiar stereograph, devised some years ago by Prof. Hines, of Pennsylvania, which viewed by momentary illumination showed that binocular effects are obtainable without the eyes of the observer being in such a condition as to make the perception of double images possible in any part of the binocular field of view. These experiments were performed not only with parallel vision, but also with strong convergence of visual lines, and the disturbance of judgment, due to unusual muscular conditions, was strongly brought out in this way.

AERIAL NAVIGATION PRACTICABLE.

Mr. Joseph L'Etoile, of the Department of the Interior, Ottawa, read his paper on "A Review of the Subject of Atmospheric Current, Electricity, and Gases, with a view to Practical Aerial Navigation by means of Balloons." The paper was illustrated with a proposed balloon of fish-like form with a screw at one end and a rudder at the other end. He said that the system of practical ballooning means that a balloon should ascend without loss of ballast and should descend without waste of gas. The balloon of the future should be given the shape of a fish provided with a propeller, a rudder, with gas and air pumps, and three gasometers, one for gas, one for air, and one for working the change of temperature in the balloon caused by the solar warmth, or moist in the air, so that by these means the balloonist or aeronaut can control his air vessel as easily as the engineer in his steamboat or locomotive. It is well known that when a balloon shoots up, the gas dilates, the gasometers or gauges tell the changes, and the balloonist adjusts to circumstances. A balloon built on this new plan can ascend or descend slowly, thus giving time to moteorological instruments to mark accurate changes. Charts could be made, and balloonists would know the routes of travel in the air, day and night, at any season of the year. To give an idea of the possibility of establishing those charts, the following may be *apropos*. For instance, a balloon sailing from America to Europe should keep within the lower region, when sailing from Europe to America it should sail in the high region. Why so? The reason is that cold air is heavier than warm air, consequently the cold Arctic currents prevail in high altitudes especially in northern Europe and America.

NEW COMPANY REGISTERED.

SOUTH STAFFORDSHIRE ELECTRIC LIGHTING COMPANY, LIMITED.—Capital £100,000, in £5 shares. Offices, 33, Waterloo Street, Birmingham. Objects: To produce and supply electric light, heat, and power, and also to carry on telegraphic and telephonic business. Signatories (with one share each): R. Williams, Wednesbury; T. Underhill, M.D., Darlaston; J. Smith, Wednesbury; E. Horton, Darlaston; J. C. Tildersley, Willenhall; J. Harper, Bilston; E. H. Carter and E. Pritchard, C.E., Birmingham; J. Solly, Tipton; J. Davy, West Bromwich; E. Howe, Tipton; L. Parker, Birmingham; P. D. Bennett, Edgbaston; Joseph Smith, Wednesbury; J. Slater, Darlaston. The signatories are to appoint the first directors. Qualification: £250 in shares or stock; the shareholders in general meeting will decide the remuneration of the directors. Registered August 31st, by Walter Webb and Co., 23, Queen Victoria Street.

NEW PATENTS—1882.

4158. "Apparatus for measuring and registering electric currents." A. L. LINEFF. Dated August 31.

4159. "Telephonic apparatus." J. H. JOHNSON. (Communicated by A. D'Arsonval.) Dated August 31.

4160. "Telephonic instruments." J. D. HUSBANDS. Dated August 31.

4162. "Electric lighting and apparatus, and fittings to be used therefor." T. T. SMITH. Dated August 31.

4168. "A new or improved carbon for use in arc or incandescent electric lamps, also applicable as the porous plates of secondary or polarisation, or other batteries or instruments, and for other analogous purposes." H. J. MARSHALL. Dated September 1.

4178. "Secondary or storage batteries." D. G. FITZGERALD and T. J. JONES. Dated September 1.

4180. "Manufacture of carbons for incandescent electric lamps." J. JAMESON. Dated September 1.

4186. "Voltaic batteries." L. HARTMANN. Dated September 2.

4192. "Electro-hydraulic meter for the measurement of electric currents." R. HAMMOND and L. GOLDENBERG. Dated September 2.

4198. "Galvanic batteries." E. B. BURR and W. T. SCOTT. Dated September 2.

4212. "Production and treatment of carbonised material to be used for filtration, and in the construction of electrical batteries, and for other purposes. J. H. JOHNSON. (Communicated by A. Caron.) Dated September 5.

4220. "Improvements in the electrical regulation of steam and other power engines and pumps, and in apparatus to be used therefor." A. W. L. REDDIE. (Communicated by A. Krásza and J. Schaschl.) Dated September 5.

4235. "A more simple and effective mounting, or holder, for filaments in electric incandescent lamps." L. R. BISHOP. Dated September 6.

4238. "Manufacture of incandescent lamps and apparatus therefor." W. CROOKES. Dated September 6.

4246. "Electric signalling apparatus, chiefly designed for telephonic purposes." W. R. LAKE. (Communicated by J. H. Cary.) Dated September 6.

4248. "Galvanic batteries." G. C. V. HOLMES and S. H. EMMENS. Dated September 6.

4250. "Dynamo-magnetic electric machines and magnets to be used in such machines, and for other purposes." T. DONNITHORNE. Dated September 6.

4251. "Obtaining and utilising electric currents." T. SLATER. Dated September 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1881.

5578. "Transmission of motive power." W. G. S. MOCKFORD. Dated December 20. 2d. For this purpose, in place of using an endless cord or rope working over V grooved pulleys on the two shafts, or a band working over band pulleys, as heretofore usual, the inventor employs an endless cord or wire, or rope or chain, twisted with one or more twists or turns around a pulley or wheel on each of the shafts. In this way the cord, wire, chain or rope will have a great hold upon the pulleys, so that even when extremely slack there will be no slip of the cord, wire, chain or rope over them. In many cases it is sufficient to use a plain piece of wire, but in other cases wire rope would be preferable. (*Provisional protection not allowed.*)

5632. "Construction of incandescent lamps." J. S. SELLON. Dated December 23. 2d. This invention relates to the employment as a substitute for transparent glass as now ordinarily employed in the construction of incandescent lamps of such glass as is known as opal, that is to say, a semi-opaque or non-transparent glass. In carrying out the invention, the inventor either constructs the glass or bulb of the lamp of glass which has been rendered opalescent through its entirety or which has been rendered partially opalescent either by means of an internal or external lining, enamel coating, or application of an opalescent material. It will be understood that the bowl bulb or glass to be employed in the construction of incandescent lamps may be rendered either wholly or in part opalescent, that is to say, that either the inferior, the middle, the lateral, or the superior portion or the whole of the bowl bulb or glass may be coated or rendered opalescent. (*Provisional protection not allowed.*)

1882.

198. "Electric block signals, &c." J. RADCLIFFE. Dated January 13. 6d. The electric locking apparatus for levers is designed with the view to prevent the signalman of a railway from [illegible] his signal or shifting his points until he has received the signal "line clear" from the station or signal box in advance. In the improvements the inventor insures the locking of the signal lever by means of a vertical or nearly vertical bolt or bar, suspended from its upper end over a projecting tongue or shoe attached to and forming part of the clip-lock of the lever. A link attached to the armature of an electro-magnet is connected with the bolt or bar. The electro-magnet is connected by the conducting wire with the block-signalling telegraph instrument at the station or signal-box in advance, and in such a manner that an electric current is only passed to the electro-magnet when the block-signalling instrument is at "line clear."

297. "Galvanic batteries, &c." J. HIGGIN and A. J. HIGGIN. Dated January 20. 6d. Has for its principal object to lessen the cost of the production of galvanic currents by means of batteries and to this end elements and materials are employed which will furnish useful and valuable chemical products. In the description of battery which is considered to be most suitable to the purpose tin is employed for one element and carbon for the other, and dilute sulphuric acid for the exciting medium. In one form of a battery cell there is used a receptacle such as a stoneware jar in which is a hollow cylinder of tin with an inner porous cell containing a carbon rod or plate, which is surrounded with granular pyrolusite or manganese peroxide, which is used to absorb developed hydrogen. During the action of such a battery the action of the dilute sulphuric acid produces proto-sulphates of tin and of manganese which remain in solution. When it is desirable to renew the exciting liquid the solution obtained from the battery is treated in order to obtain such preparations of tin as are required in the dyeing and printing of textile fabrics and in other industrial processes. It is preferred to heat the solution with an added quantity of oxide of manganese, whereby the proto-sulphate of tin is converted into a per-sulphate. It is then only necessary to dilute the resultant with water in order to precipitate stannic acid or oxide from which other preparations of tin may be obtained by the employment of suitable or ordinary processes.

300. "Fire-extinguishing and alarm apparatus for use in theatres, &c." W. R. LAKE. (A communication from abroad by H. S. Maxim, of Brooklyn, New York.) Dated January 20. 8d. Has for its object to provide improved apparatus for automatically giving an alarm in case of fire and for extinguishing the same, the said apparatus operating by electricity and being caused to work by the action of the fire upon certain appliances suitably arranged.

339. "Regulating electric lamps." ERNEST DE PASS. (A communication from abroad by Bruno Abdank, commonly called Abakanowicz, of Paris.) Dated January 23. 6d. Has for its object to regulate electric lamps, by means of novel apparatus, or resistance balances, and which may be placed at any convenient distance from the lamps.

359. "Electric lamps." J. N. ARONSON. Dated January 24. 8d. Has for its object improvements in lamps in which several incandescing bridges or filaments are combined in one translucent globe or containing vessel, in which several globes or vessels, each with a single bridge or filament or are combined in one cluster, and in means or apparatus for bringing the said bridges or filaments of the lamp or of the clusters of lamps successively in the electric circuit automatically or by hand.

361. "Electrical conductors, or cables." W. R. LAKE. (A communication from abroad by H. A. Clark, of Boston, America.) Dated January 24. 6d. One object of this invention is to prevent the inductive action between the different conductors of a series lying adjacent one to another. Another object is, in electric cables composed of a series of wires, each and all surrounded and coated, and thus insulated with india-rubber, or gutta-percha, or restored waste, vulcanised india-rubber, or gutta-percha in any of their vulcanisable compounds, or with any other gum, or gums capable of vulcanisation, and suitable for insulation, to insure and maintain the proper separation and position for insulation of the several wires making up an electric cable, as to each other, during the process of vulcanisation. To secure the first-named object the inventor places a conductive body of considerable size, relatively to the size of the wires, close to the insulating coating of a series of insulated conductors, laid side by side, so that the electric impulses in any one of the said lines will expend their energy on the said conducting body rather than on the other lines of the series. To secure the second object of this invention the inventor places such cables in an oven, to be vulcanised, in moulds of a shape to maintain them in a practically straight condition from end to end of such moulds, and then vulcanises them in the ordinary manner, whereby the proper and relative positions for insulation of the wires on the cables are maintained, and the mould, containing a portion of a cable, being vulcanised as above stated, is made to project from the vulcanising oven, or chamber at the opposite ends thereof.

378. "Signalling apparatus for railways." W. P. THOMSON. (A communication from abroad by W. W. Gary, of Boston, America.) Dated January 25. 4d. The object of this invention is to provide a simple, reliable, and inexpensive single mechanism for use at crossings, curves, stations, and all other places at which audible or audible and visual warning is to be given when trains are approaching. (*Provisional only.*)

386. "Cores for telegraph cables, &c." W. T. HENLEY. Dated January 26. 6d. Refers firstly to the construction of a core with multiple conductors which may be used at will for a number of circuits, or for a few, or as one only, so that in an Atlantic cable, for example, for one part of the day or night it might be used as several telephone circuits, and the rest of the day or night as an ordinary telegraph cable of one circuit. This is done by a switch which, when turned in one direction, connects all the conductors in one circuit, and in the other direction connected in separate circuits from two upwards;

there must be a switch at each end of the line and at a given signal the switches must be set. The conductors are first insulated separately and then all closed in another coat of insulation, and then served with yarn and protected with wires in any well-known way; but in the improvement the core is surrounded with strong manilla or Russian hemp or strong fibrous material, laid up in closely spun yarns, which are laid round the core in long spirals and then served with galvanised steel wires of a small size, so as to combine lightness with strength; the cable is then covered with tape or yarn and compound in the ordinary way.

DISCLAIMER.

The Edison Electric Light Company's Disclaimer and Memorandum of Alteration. (Edison's Patent.) "Electric Machines and Motors." No. 1385. 1880.

CITY NOTES.

OLD BROAD STREET.

DEVON AND CORNWALL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Wednesday the statutory meeting of the shareholders of the above company was held at Cannon Street Hotel, under the presidency of Mr. W. H. Owen.

The notice convening the meeting having been read by the secretary, Mr. F. B. Lidstone,

The Chairman said: Gentlemen, this is what may be termed a statutory meeting. It is the meeting which is usually held in accordance with the statute regulating joint-stock companies' proceedings. It is provided that the first general meeting should be held within four months from the formation of the company. Usually there is nothing to say at such a meeting, further than to give such information as the shareholders may desire to have, and that I shall proceed to give you as shortly as possible. The first thing I may say is that I rather regret there are not more shareholders present than I have now the satisfaction of seeing. In one sense the directors may take that as a compliment to themselves, for if any large number of shareholders had been dissatisfied with the position and affairs of the company there would have been more here to make complaint of it. The directors are glad to have the opportunity of giving you an account of their very brief stewardship, and you will probably not expect to hear that much business has been done. The very nature of the thing we have to offer to the public is not such as to admit of its instantly being shown for a purchase to be made instantly. The introduction of the electric light must be carried on very cautiously, carefully, and quietly. It is a thing, as we say in common talk, of which the thin edge of the wedge has to be got in and then it may be driven home. There is a strong interest opposing the electric light —namely, the gas interest. The people to whom the electric light is offered like generally to drive a bargain for themselves. They say, "Oh, yes, we shall be very glad to have the light, but you must let us have it at the same price as we get gas." But we reply, "You cannot have a better article at the same price." This is the way we have been met, and we shall be met in future. Still there is a prospect of doing something, particularly in Plymouth, which is a very enterprising place. Plymouth has received the offer of the light very cordially indeed. The directors are now negotiating for installing the light there. I hope you will approve the course the directors have been pursuing. They have not been anxious to jump at anything or accept always the terms offered. If they went into matters in an improvident way they would spend your money to no profit. There has been a little commencement made. There was a very extensive fancy fair in the city of Exeter recently, and the light was shown there. The hall was lighted up, and it was well done, and payment was made to the company for three days. There was a further day upon which the light was used, and which was agreed to be paid for, but has not been yet; and there was a fifth day on which the light was used, and it may be a matter of transfer. We have had the use of a cellar in the hall for storage purposes, and one will be a set-off against the other for rent. The directors are of course anxious to make money by the exhibition of the light at Plymouth to some persons desirous of having it. There would be in addition to making money an opportunity of advertising ourselves, and advertising our light; and when the light is exhibited in a business place like Plymouth, I think it is more than probable, almost certain, that the people in Plymouth will, after having seen the light, take more kindly to it than they are at present disposed to do. There are, moreover, prospects in the dockyards. At Portsmouth they use the electric light upon the Brush system. I was told, on applying to the authorities at Devonport dock, that they are now about transferring some light from Portsmouth, where it is not wanted, to Devonport dockyard, where electric light is wanted. So that there is some prospect of doing business there. I may say this, that I am rather sorry one or two shareholders have expressed some dissatisfaction at the directors not having done any business. Business can be done to any amount almost if you pay out money, but we look for a return. There is another undertaking at Penzance. There are the head-quarters of the mining industry of Cornwall. There is a very large field in the Cornish mines for the introduction of the light. Although we are not working in the colliery district, still I take it that mines are on the same footing. The electric light would be of immense service and of immense utility in the mines of Cornwall. Penzance being the headquarters, there is a good reason why we should make an exhibition upon the undertaking of Penzance paying for it. It would be a very good advertisement to us in a very large district without any expense to ourselves. I shall be happy to give any further information that any shareholder may desire if any shareholder has any question to ask.

Mr. J. S. Tyler asked whether and why the directors issued the prospectus stating that the directors had the exclusive right to use or sell in Devon and Cornwall the Lane-Fox incandescent lamp? He found on searching the patent register that on the 27th July, 1881, Mr. Lane-Fox granted a general licence to the British Electric Light Company for the use and sale of his lamp, and it seemed from the register that that licence was granted in consequence of the agreement which Mr. Lane-Fox had previously entered into with the British Electric Light Company, and in consequence of proceedings the British Electric Light Company took against Mr. Fox in Chancery. He found no revocation of that licence whatever. Even if it were revoked it had not been recorded, and that was a serious matter for this company. He should like to ask if the licence to the British Electric Light Company had been revoked; what was the position of the company in respect of the rights of the liquidator, if there should be one, of the British Electric Light Company, or the trustee in bankruptcy, if there should be one of the Lane-Fox? Then, if the answer was that the licence was revoked, he should ask how and when it was revoked, and why the directors, through their solicitors, did not take care that such revocation was registered. He further wished to know what was the exact terms of the parent Brush Company and whether any contracts had been signed or entered into by the directors since his interview with them yesterday? Perhaps he might be allowed to inform the meeting that he had not put these questions to the chairman off-hand, but that he called on the secretary yesterday and told him, as he got no satisfactory answer then, that he should put them at the meeting.

The Chairman said the questions might be formally put into one.

Mr. Tyler said he should like further to ask why the directors did not through their solicitor take care that the revocation, if such was the case, was registered. He omitted to say that the Anglo-American (parent) Brush Company do not now grant the licences they used to do. Formerly they granted licences for the exclusive right to use the Lane-Fox; now they give one for the use only.

The Chairman: Can you give us the date?

Mr. Tyler: About three months ago; after the Metropolitan.

The Chairman said that alteration was made subsequent to the formation of this company from circumstances which came to the knowledge of certain persons. The question resolved itself into this —Was it not a fact that such and such a transfer had been made—he was using his own words—whether, in fact, they had the exclusive legal right to the use of the lamp, or whether they had not? His answer was that unless the directors really supposed that they had such exclusive right they would not have issued such a statement. The company did not know of anything to the effect that they had not the exclusive right. If a fraud had been committed upon them by the sellers they had their remedy. Nothing had been signed or done since yesterday afternoon. The Anglo-American company saw the prospectus before it was issued, and if they saw anything they disapproved he took it that they would have had the honesty to say, "Well, you are preparing to use something we have not sold you."

Mr. Shippey failed to see what was the immediate hurry for winding-up the company. He was a small shareholder, and he could bring to the use of the company a lamp for mines which would return 50 per cent. for their money. It was absurd to propose the winding-up of the company when electric lighting was only yet in its infancy.

The Chairman said he thought the remark was a little beside the mark; he had heard no direct hint about winding-up the company.

Mr. Tyler said he thought the answers given extremely unsatisfactory. Was it a fact, or was it not a fact, he wanted to know, that on the 27th July, 1881, Mr. Lane-Fox granted a licence to the British Electric Light Company for the exclusive use and sale? He had carefully taken the numbers of the patents from the register, and they corresponded with the numbers in the company's book, and it was quite clear that the licence dealt with by the British Electric Light Company was that identical patent this company had the right to sell and use in Cornwall. He could not conceive why the directors wanted to go into a groove which was opposed to that of the shareholders. Some inquiries should be made. Renshaw's were very accessible. Why was not information sent for from them, asking if it was a fact that the licence was revoked? The information could be got in a minute. There had been time that morning to make inquiry. The whole thing was in a nutshell. Although he was only a young man he had had some experience.

The Solicitor: In winding-up?

Mr. Tyler: No; not in winding-up companies (laughter).

Mr. Tyler said they were dealing with promoters' nominees, practically. And in these days, when promoters' nominees were qualified by promoters' money, he thought it behoved every shareholder in a company like that to be very careful what he was about, and in view of what had been discovered on the register concerning this company, he thought they ought to appoint a small committee of independent shareholders—not officers of the company—to investigate this matter of the licence between the British Electric Light Company and the Anglo-American. If a shareholder had come to him, as a director, he should have treated him courteously; but he was not received courteously. Not an inquiry had been made, although the solicitors were on the spot with the information in their pockets. If the board considered that satisfactory he must submit that he did not. He was only the holder of twenty-five shares, but he did not like losing his money. He was of opinion that there existed that licence he spoke of, and that there existed, in consequence, the necessity for this investigation. If the prospectus was wrong there must be a question of the personal responsibility of the directors, at any rate of their solicitors. What they ought to have done was to have searched the

register. One gentleman at the meeting yesterday said that the Anglo-American had a million of money at its back. He believed it was public knowledge that that company had parted with nearly all the money they had got, and that, taking all the money they were entitled to, and taking the shares as money, the sum does not reach half a million. He was perfectly satisfied in his mind that if the licence with the British Electric Light Company still existed, the Anglo-American, to save themselves, must come down with the damage or there would be a serious question whether the directors were responsible to the shareholders. He moved that a small committee be appointed, as he had suggested.

The Chairman said the previous speaker needed to be very careful how he dared to make such statements as he had, involving a clear untruth. That gentleman said that the directors were promoters' nominees.

Mr. Tyler: No. I said in these days when directors are promoters' nominees.

The Chairman: The gentleman appears to me to desire to disclaim what——.

Mr. Tyler: No.

Mr. Maudsley: May I beg you to sit down? I am a shareholder in the Anglo-American, and a director in the Great Western, and I hold 1,000 shares in this company, and I have paid every farthing, as every director has.

Mr. Tyler: You treated me very civilly, and were the only one.

Mr. Maudsley continuing said that this company hoped one day, not only from the effect of electricity itself, but also by the combinations which some of them had in connection with these county companies, that they would be able to establish many which would be for the benefit both of sellers and consumers. He thought that the statement concerning the legal points raised between the two companies he (Mr. Tyler) had named, had nothing to do with this meeting at the present time. This company had not only the influence but the consideration of men in different companies who are working for the general good, who were trying to carry out the system which it is intended to develop. Scientific minds are at work, some of them having patents are hoping to improve upon the machinery, by which the money invested in these companies will be lowered in primary cost, and that it may become useful to all and to every one who may be ready to use it.

The Chairman said the statement that the board were the nominees of promoters could not be tolerated for a moment. He was about to say, when interrupted, that it having appeared that what Mr. Tyler said, or intended to say, had been misunderstood. It seemed to him that Mr. Tyler disclaimed that which he is supposed to have said. He wished to say that in Mr. Tyler making allusion to the board of directors of this company there was a distinct insinuation that the directors were the nominees of promoters. Not one director has received any qualifying assistance, aid, or help in any way. He thought one director having 1,000 shares was a sufficient guarantee that Mr. Maudsley meant what was right towards that company, and would not tolerate one director associated with him being the nominee of a promoter.

Mr. Tyler: But what about the licence?

The Solicitor (to Mr. Tyler): If you will come to my office I will show you the licence. The onus is now upon you. You make a statement that we have no right to the Lane-Fox. The title is perfectly good; there is not the slightest ground for your surmises.

The Chairman said Mr. Tyler had made many curious inquiries except the right inquiry, keeping aside all possibility of removing any doubt. He had established those doubts in his mind, and he had cast them out broadcast. He said, in fact, "I told you yesterday that those doubts existed; why have you not made inquiries?" He said, in fact, "Do you know what you have is worth nothing?" Well, the board did not know that to be the case, but said they would talk it out at the meeting to-day. But why did not Mr. Tyler pass a little more time in going to the solicitor whom he named? saying, "I dare say you can give me this bit of information. I am a shareholder in the Devon and Cornwall."

Mr. Tyler: They would not give me an answer.

The Chairman: Be quiet, sir. You must not interrupt me.

Mr. Maudsley: Do sit down, please, sir.

Mr. Tyler: I will sit down for any other shareholder, but I shall not for you. They would not give me an answer.

The Chairman: You must not interrupt me ("Chair, chair"). Why did you not give us time to make the inquiry? This gentleman came to the office late yesterday afternoon, when all offices were about closing, so that we had not fair time to make the inquiry.

Mr. Russell Evans (a director) said Mr. Tyler's remarks at first did not strike him as pointing to the winding-up of the company; but he could see now that whatever his views might be with regard to the licence, it was the winding-up of the company to which the tendency of his remarks pointed. He was always under the impression that when people had a large sum of money behind them they were a good mark to shoot at, if they sold what did not belong to them. The Anglo-American had a large sum of money not called up upon their shares. He thought the shareholders of the Devon and Cornwall had excellent clients to shoot at if they had not got a good thing. Mr. Tyler had no right to say that Mr. Lane-Fox was a poor man. He (Mr. Evans) felt as satisfied about everything connected with this company as he was of the licence; he should be assured that everything was perfectly safe.

The Chairman said Mr. Tyler's statement was not in order at that meeting. The seventy-seventh clause of their articles of association said that "it is provided that any member entitled to be present and vote at a meeting may submit any resolution to a general meeting provided that at least the prescribed time before the meeting he shall have served upon the company notice of motion," which Mr. Tyler had not done. The directors wished to take the shareholders into their confidence, and to keep nothing back.

Mr. Phillipson: I will second Mr. Tyler's motion.

The Solicitor: Are you in arrears with your calls?

Mr. Phillipson: You are very rude to ask that question.

The Chairman: The question is asked because if you are in arrears you have no right.

Mr. Tyler: He rose because you said you doubted whether I should get a seconder.

Mr. Shippey said his heart and soul was in electricity. He felt that they should do all they could for the interest of their little baby company. He spoke thus of the company because he believed in it; he thought that there was a lot of lighting to be done in the mines of Cornwall.

After a vote of thanks to the chairman, proposed by Mr. Shippey and seconded by Mr. Underell, the proceedings terminated.

THE LONDON AND PROVINCIAL ELECTRIC LIGHTING AND POWER GENERATING COMPANY (LIMITED).

THE first ordinary or statutory meeting of the above company was held on Thursday, the 7th inst., in Cannon Street Hotel, Lord Wallscourt presiding.

The secretary, G. H. Redwood, Esq., having read the notice convening the meeting,

The Chairman said: Gentlemen, I have a short *résumé* of the company which I am going to read to you. As you are no doubt aware, this, the first statutory meeting of the company is held in accordance with the Companies' Act within four months of registration. It is not usual at such meetings to trouble you with any statement of accounts. You will, no doubt, however, be desirous of receiving some particulars of the progress of your company since the allotment of shares, which took place on May 15th last, when the number of shares allotted, including vendor's shares, represented a total share capital of, say, £69,000. In the first place, to carry out the object of the company it was necessary to take suitable premises, in respect to which some delay occurred. Finally, however, it has been arranged to rent premises at 42, Newington Causeway, in the centre of a very important lighting district, which are now being fitted up as an exhibition of the company's system of lighting. These premises will be opened for the inspection of shareholders at an early date, of which due notice will be given. I need scarcely remind you, gentlemen, that in the practical adaptation, electrical lighting is yet still in its infancy (hear, hear), entailing the greatest care and caution in taking the first steps in respect to contracts. It should be here observed, that the directors have had under their consideration contracts for various important places—Malta, the Brighton Aquarium, &c., but up to the present time no contract sufficiently advantageous has been concluded. It will be satisfactory for you to learn that negotiations are pending, which if carried out in their present shape will, it is believed, give a wholly satisfactory result. It will be, however, obvious to you, seeing the competition in the field, that to disclose at this stage the names of places or persons would be highly impolitic. The field is large, and there is no lack of business.

In conclusion, the directors recommend the shareholders to use their best exertions in the interests of the company. If any gentleman has any question to ask, we shall be glad to hear him.

Mr. Sheridan would like to ask whether the manager of the company was satisfied with the progress made up to the present time with the negotiations.

The Manager said, that having assumed office only during the last three weeks, that was rather a short data to build upon in giving expression to any opinion as to the prospects of the company. It might suffice to say that proposals were daily forwarded to the office, and estimates and contracts furnished, but as to the actual business results, it was a little too early yet to go into such matters. He hoped that at their meeting next year, in May, that a good statement of accounts would be laid before the shareholders.

On the motion of Mr. Deere, seconded by Dr. Suckling, who said that they ought to be well satisfied at having a board with such business capabilities, a unanimous vote of thanks to the chairman and directors was adopted.

The Chairman briefly responded, and the proceedings terminated.

CABLE INTERRUPTED.—The Shanghai Nagasaki cable being interrupted, messages for China can only be forwarded by the Indo-European Company's line. All messages should be marked "*viâ* Indo."

QUOTATION has been granted to the South African Brush Electric Light and Power Company, Limited, shares.

SPECIAL Settling Day has been granted to the Provincial Brush Electric Light and Power Company, shares; and also to the South African Brush Electric Light and Power Company, Limited, shares.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of August was 2,581, estimated to produce £2,550, against 2,354 messages, producing £2,401, in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of August, 1882, are £1,790, as against £1,507 in the corresponding period of last year.

The Great Northern Telegraph Company. The traffic receipts in August, 1882, were £23,360 from the 1st January to 31st August, 1882, £169,560, in the corresponding months of 1881, £158,240, and in the corresponding months of 1880, £154,075.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending 1st September, 1882, were £2,464, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited.

West India and Panama Telegraph Company (Limited). The estimated receipts for the half-month ended the 31st August are £1,962, as compared with £1,763 in the corresponding period of 1881.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 251.

THE ELECTRIC LIGHTING INDUSTRY.

THE universal interest in electric lighting which, until the summer months set in, had occupied the minds of financial men and the public generally, seems to have declined to a certain degree. Signs however are not wanting to show that there is a tendency for the new industry to regain its former hold upon the public mind. That such should be the case is most desirable, and the forthcoming winter should show a great advance in electric lighting operations. It is more than probable that a considerable number of the companies which have been floated during the present year would now have been on a much firmer footing had not the speculations in shares of certain leading companies made it a matter of doubt to intending investors and users of the light, as to the *bonâ fide* nature of the new ventures. It is scarcely to be expected that the shares of which we speak will ever again attain the fictitious value hitherto attached to them, for although such a contingency might happen under certain circumstances, we think it is in the power of other companies to restrict their value to a more reasonable amount. There can be no question but that the systems of several of the recent companies can be made to compete on favourable terms with those now so firmly established, if the undertaking is conducted on a right basis. We have never advocated the use of such a number of lamps in one circuit as to necessitate the production of a dangerously high electromotive force, and probably it is only a question of a short time for the limit in this matter to be settled by legislation. The majority of systems do not employ more than ten or twelve lamps on one circuit, and are therefore considered by the mass of interested, but uninformed, observers as being less efficient, economical, or simple, than those actuating twice or three times that number of lamps from one machine.

Leaving out the element of safety, which we must all admit forms a most important consideration in selecting a system of electric lighting, there are certain advantages attached to machines of low tension, even though the number of circuits must be increased two or threefold. It is not likely that a mishap would happen to more than one machine or one circuit at the same time, unless in such an extreme case as the steam or gas-engine breaking down. It is more to the manufacture of dynamo-electric machines that we wish now to draw attention. The present price of machines giving, say, two or three arc lights of the usual power is comparatively high compared with those constructed to produce sufficient current to operate twenty or more, and this may be partly accounted for by the rule of thumb method generally adopted in the designing of such machines.

Up to the present no systematic designing of machines for special work to be performed has been thoroughly entered into, the result being in many cases a wasteful expenditure of power. The field magnets of dynamo-electric machines, which form one of the chief items in their efficiency, are in most cases treated with the least consideration. The copper wire with which they are wound forms a great part of the expense of construction, and we have known frequent instances of machines manufactured so that a considerable portion of the wire round the field magnets has been absolutely useless, and therefore so much waste. After saturation point is reached by winding on a certain number of convolutions, any extra number of turns adds useless resistance to the circuit, and absorbs power inside which should be utilised externally. We shall be able, perhaps, to show our readers a practical example of this in a short time. The masses of metal composing the cores and projections of the electro-magnets are also important matters of consideration in designing the most effective and economical form of dynamo-electric machine. Mr. Edison has produced the only specially suitable machine for electric lighting by incandescence with which we are acquainted, and although this was criticised when exhibited in the Paris Exhibition by the correspondent of a leading newspaper as a machine such as no electrician would have designed, we imagine that he no longer holds the same view. Electric light companies preparing to compete with established systems should endeavour to construct the armatures and field-magnets of their machines according to the work to be done in the external circuit, and economy of manufacture, and therefore reduced selling prices will be the result. £5 worth of wire too much on a machine manufactured for a certain purpose will probably mean an addition of £10 or £12 to the price asked for its purchase.

The subject of electric lighting, however, has surely made sufficient headway to enable competing companies to lay down a course to pursue such as will command success. If not they have only themselves to blame; for, although the public interest is not now in such an excitable condition as at the beginning of the present year, it is probably of a more thoughtful and deeper nature, and those companies prepared to do good work will certainly not have to wait for patronage, for the innumerable advantages of the electric light are becoming daily more and more apparent.

A NEW PHOTO-ELECTRIC BATTERY.—A new battery, which gives a current on exposure to the action of light, has been devised by M. Saur. It consists of a square glass vessel, containing a solution of 15 parts common salt and 7 parts sulphate of copper in 106 of water. A porous vessel of mercury is placed in the solution. An electrode of platinum is in the mercury, and another of sulphuret of silver in the saline solution. The electrodes are connected by means [illegible] in a box shel- [illegible] it displaces the ne[illegible] that the sulphuret of si[illegible] the needle has come to rest, [illegible] the light of the sun the deviation [illegible] is suppressed the needle returns to it[illegible]; if a cloud passes before the sun while the b[illegible]posed to the light the variations of the needle indica[illegible] the fluctuations of the electric current. The effect of the battery is due to the action on the mercury of the bi-chloride of copper formed by the mixture of common salt and sulphate of copper. The proto-chloride of copper which is formed reduces the sulphuret of silver; but this reduction requires the intervention of the solar light, which determines the production of the photo-electric current.—*Les Mondes.*

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FIG. 21.

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sustained. A finger, *d* (fig. 20), placed upon its prolongation acts then upon a bar lodged in the vertical axle and produces, by the action of a series of levers and stops, the disengagement of a cam which puts in motion the printing mechanism. This mechanism is composed of two wheels, one called the printing-wheel and the other the type-wheel, mounted upon the same axis, with an arrangement which allows the relative displacement of the second in respect to the first, when it is necessary to make the impression of figures or of letters. This arrangement has been borrowed from the Hughes apparatus: we will not describe it. In the ordinary motion the printing-wheel and type-wheel have a common movement. In the printing-wheel each division is formed of a tooth and a hollow, in the type-wheel each division is subdivided into two parts containing two characters (a letter and a figure).

When the cam of fig. 20 is disengaged it enters a hollow of the printing wheel and accompanies this wheel in its movement until in a position symmetrical with respect to the line of the centres. It leaves then the hollow and takes up a second position by the action of a spring outside of the path of the teeth of the printing wheel. The fixed axle round which the cam turns bears on its prolongation an arm, called the printing arm, which is drawn along by the motion of the cam and projects the paper against the type wheel. A pin on the printing wheel acts at one part of its revolution upon the arm of a lever which turns around a horizontal axis and strikes again by means of its lower arm the cam, and restores it and the printing arm to their original position. This lever is represented at the upper part of fig. 21. The rest of the figure gives the details of the mechanism for the

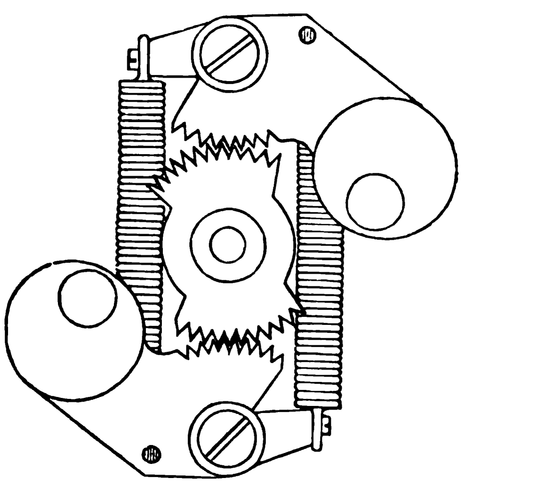


FIG. 22.

propulsion of the paper. The ribbon is furnished by a roller placed at the right of the receiver, and after several angles it eventually passes round the extremity of the printing arm, which is covered with cork, and finally is brought against a cylinder with a toothed surface and an adjacent roller pressed by a spring. The grooved cylinder is provided with two catches, *d* and d^1, the motion of which impels the paper. At the first stop and impression the catch, *d*, which is movable with the printing arm, draws on the cylinder; the catch, d^1, is fixed. The ribbon does not advance, but upon the right a certain length of paper, coming from the roller, is impelled by the rotary motion of the arm. On the return, the fixed catch retains the cylinder, the paper in contact of the roller does not move, but the portion which has received the impression slides over the cork and is replaced by another to receive the next character.

Fig. 19 represents a double receiver, doing service on two circuits, not consecutive, by the aid of a single motor and of a single combiner; the printing parts are double, and placed upon two opposite surfaces. The receiver is completed by two parts, called the speed regulator and brake regulator.

The speed regulator is arranged in such a manner as to be able at a given time to absorb a given portion of the power of the motor, the resisting couple varying in relation to the slight differences in the speed of rotation.

The fly-wheel of the apparatus turns eight times as quickly as the commutator, making from sixteen to twenty revolutions per second. The axle of the fly-wheel bears upon its prolongation two arms, terminated by sockets, into which are screwed two buttons, supporting two eccentric masses (fig. 22). Spiral springs, fixed at one end to the springs, and at the other end to the masses, tend to bring these back towards the centre, and act in the reverse direction to the centrifugal force developed by the rotation. The masses carry two small cork rubbers, sliding upon the concave surface of a metallic disc.

The speed regulator is completed by the brake regulator, which insures synchronous motion between the receivers and the distributor. Each double receiver possesses an electro-magnet, arranged near to the fly-wheel, the armature of which brings down a small hammer with a cork head. By the displacement of the armature, the hammer presses upon the circumference of the fly-wheel, and thus creates a resistance which diminishes the speed. Once in each revolution the sixth rubber of the distributor traverses the contact, called the brake-contact, and puts it in communication with the local battery which actuates the electro-magnet.

CAPANEMA'S PATENT PORCELAIN INSULATOR FOR BULLET-SHAPED WIRE-ATTACHMENT.

BEFORE describing this insulator we think it advisable to give a brief summary of the causes which lead to the decrease of electrical resistance observed in so many insulators after erection. It is not sufficient that a high insulating power is observed shortly after manufacture, but it is of the first importance that this insulation should remain as constant as possible, and Capanema's insulator has been designed to fulfil this condition.

Decrease of insulation or electrical resistance may be traced to the following causes :—

(1.) Chemical action which is set up when insulators of inferior quality are exposed to an atmosphere impregnated with acids or salts. (Porcelain insulators are less liable to be injured in this way than those of ebonite.)

(2.) Conducting films of dust and moisture, which frequently collect on the surface of insulators, and more readily upon a rough than a smooth surface.

(3.) Fissures and cracks caused by sudden and unequal expansion or contraction of the whole insulator or some of its parts. (The materials may, however, be so combined as to reduce this defect to a minimum. The quality and proportions of the substances employed in the manufacture of the porcelain should be chosen with a view of securing as constant an electrical resistance as practicable.)

(4.) Fissures caused by discharges of atmospheric electricity passing from the line-wire through the insulator to earth. (This occurs more readily when the insulator is of inferior quality, especially when the line-wire is attached to it by binding wire. In this case the latter, by encircling the upper part of the insulator, causes a large number of metallic points to be in contact with it, thus assisting the discharge through weak and defective places on the surface.)

(5.) The use of binding wire which frequently breaks and forms a direct contact. (When binding wire is wound round the insulator, its coating of zinc is invariably chafed off. It then rapidly oxidises through the moisture of the atmosphere, and rust is deposited over the surface of the insulator, thereby greatly reducing the insulation.)

Description of Capanema's Insulator.

This insulator has been designed with a view to avoid the above causes of defective insulation, and to obtain a method of securely fastening the line-wire to the insulator, while at the same time allowing repairs to be easily effected in case of breakage. The wire is securely attached to each insulator, so that in the event of a break occurring in any span, the insulators on each side hold the fractured wires and prevent them from slipping back in the adjoining spans.

Fig. 1 shows a section and fig. 2 a plan of this insulator. When a line is being constructed the wire is strained from pole to pole, and the place where it will rest in the insulator is marked. A bullet-shaped piece of tin-solder (the same as used for soldering joints) is then cast upon the wire at this mark and placed in the insulator. In the porcelain just above the bullet, there are two small holes for the reception of a pin which serves to keep the wire in its place. On properly-constructed lines, however, the wire is retained in the insulator by its own weight, and the pin is only required when the line has been erected in an irregular manner.

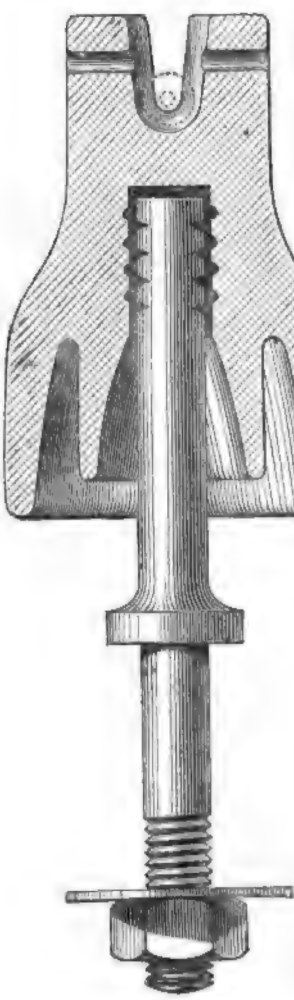


FIG. 1.

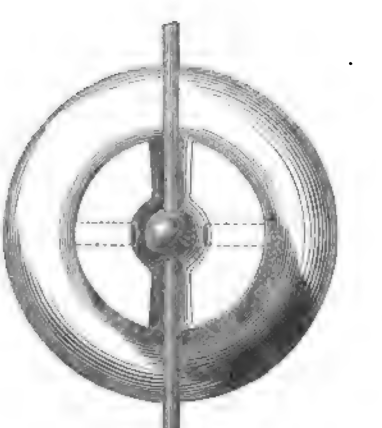


FIG. 2.

Experience has proved that the wire does not slip through the bullet, and that both are capable of bearing an equal strain. In order, however, to obtain complete security against slipping, the line-wire should be first dipped into the molten tin solder and heated, and the bullet then cast upon en the union of the metals becomes complete. facilitate this operation a bul et mould is used, through which the tin is allowed to flow, thus heating the wire, and after the latter has been sufficiently heated, the outflow of metal is stopped by a shutter, and the bullet is then formed. If the wire is not previously heated as above described, it slips through the bullet, just before its breaking strain is reached.

These insulators, which are of double-cup form, are made of the best highly-glazed porcelain, and the disadvantages attending the use of binding-wire (referred to in paragraphs 4 and 5), are avoided by the adoption of the bullet form of attachment. The line-wire, by means of this attachment, touches the insulator only at one point, so that discharges of atmospheric electricity are much less likely to destroy the insulator than when binding-wire is employed.

The method of fastening the line-wire by means of binding wire round each insulator is objectionable on account of its giving rise to loss of current during damp weather. In Capanema's insulator this leakage is greatly reduced by the small point of contact between the insulator and line-wire, and the electrical resistance remains consequently more constant.

Another advantage of the bullet attachment is, that it offers an easy and substantial way of suspending the line-wire, and in such a manner that the swinging motion of the latter is rendered harmless, and when faulty insulators require renewal, that operation can be carried out without touching the wire and interfering with the correspondence on the line.

These qualities render the insulator especially suitable for long lines with few wires in countries where constant supervision and repairs are difficult.

The favourable results obtained induced the Brazilian Government State Telegraph Department to adopt this insulator, and their lines, which are over 10,000 kilometres in length, have thereby been greatly improved in insulation.

In the discussion (on Mr. Sivewright's paper) which took place at a meeting of the Society of Telegraph Engineers on April 9th, 1879, Mr. Andrew Bell, Superintendent of the British Postal Telegraph Factories, referred to Capanema's insulator as possessing some "excellent features," and further remarked that "the metallic, or wire surface in contact with the insulator being very small diminished leakage, and another good point was that it would be free from a serious defect that attends the use of the common wire-binding. When the galvanising wears off the line and binding-wire, an oxide of iron soon covers the surface of the insulator and causes great leakage." These articles are manufactured by the firm of Messrs. Siemens Bros. & Co.

ELECTRIC CLOCKS AND TIME TELEGRAPHS.

By LOUIS H. SPELLIER.

(Abstract of a Paper read at the Stated Meeting of the Franklin Institute, May 17th, 1882.)

Two years ago I read a paper * before the Institute on the subject of "Electro-magnetic Time Telegraphs," or electric clocks that receive the time telegraphed in certain intervals from a weight or spring clock.

I then stated that "they mainly depend upon the action of one electro-magnet and one armature." The latter is a piece of iron which is attracted by the poles of the electro-magnet, when the telegraphing clock completes the circuit of a galvanic battery connected with it. As soon as the clock breaks the circuit again, the armature is repelled to its former position by a spring or weight. This movement of the armature turns a wheel which drives time-indicating machinery, and is repeated as often as this machinery requires to indicate the time of the clock, which makes or breaks the electric circuit.

Such instruments work very well if the action of the armature is needed about once every minute, but if repeated every second or two, then its imperfections become apparent. The movement of the armature is sudden and

* See ELECTRICAL REVIEW, June 1st, 1880.

rapid. With a lightning-like velocity the armature moves toward the magnet, and is checked instantaneously in its rapid progress just at a time when nearest to the magnet and most powerfully attracted. Naturally the wheel, which receives its impulse directly from the armature, moves with the same rapidity and is checked as suddenly. These sudden checks offered to the armature and wheel show their damaging results in a short time, and soon impair the correctness of such instruments.

With the aid of the accompanying cuts (figs. 1 and 2), which show the principle of my electro-magnetic escapement in its two main positions, I will be able to explain the manner in which I have corrected these evils by the invention of my system. Referring then to figs. 1 and 2, G is the electro-magnet, B is an iron wheel that has on its circumference the projections, H. Those projections are armatures. Fastened to the same axle with this iron wheel is the escape wheel, A, with the peculiarly shaped cog shown in the

FIG. 4.

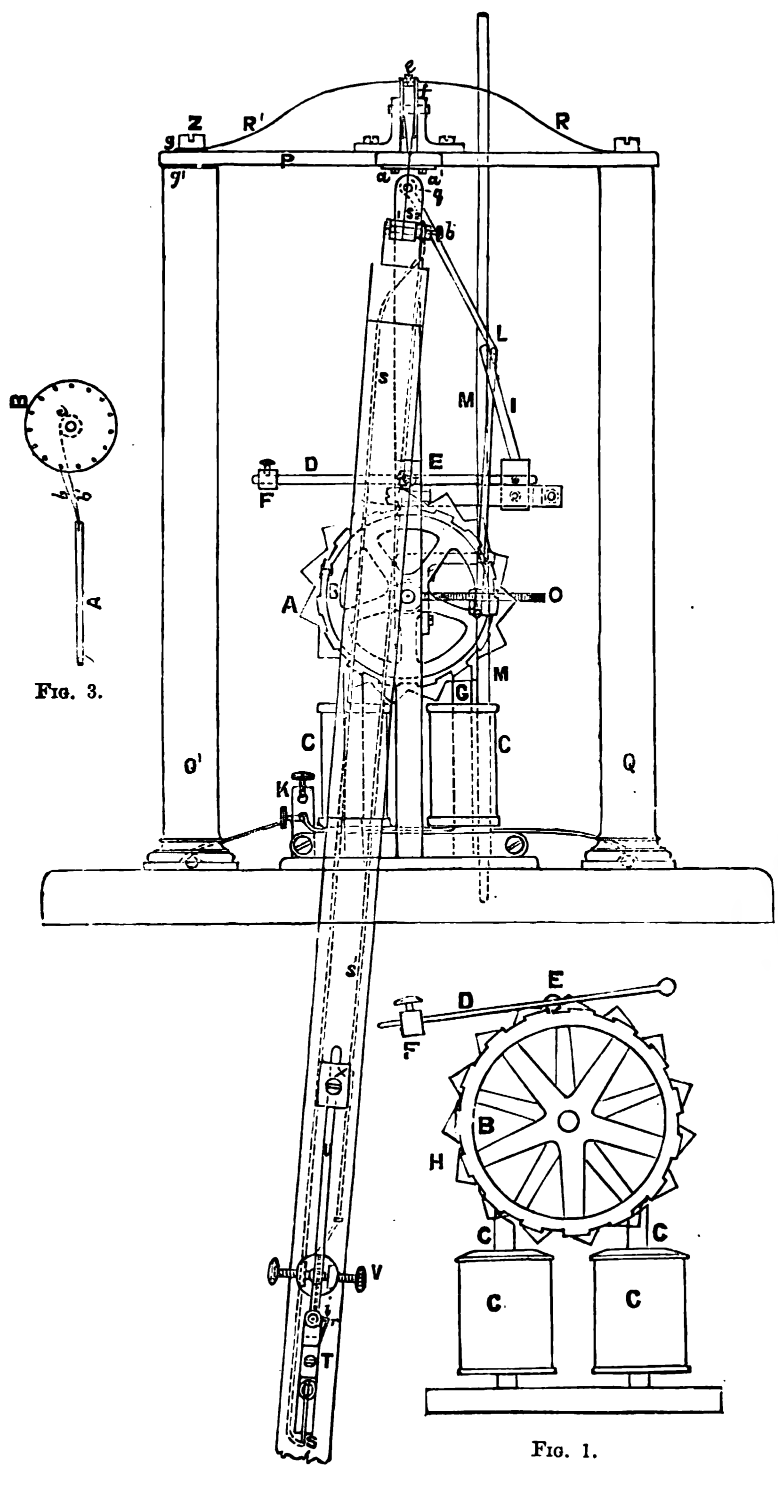


FIG. 3.

FIG. 1.

FIG. 5.

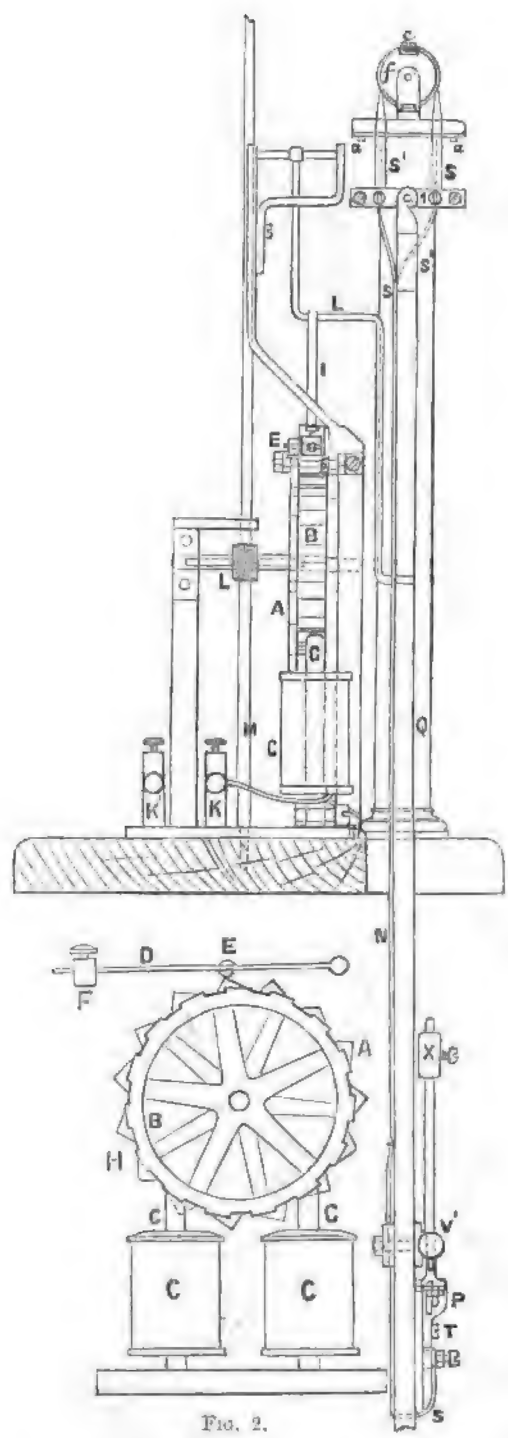


FIG. 2.

These clocks, as a rule, soon get out of repair, as may be seen by those in use at the Pennsylvania Railway Depot in this city. Their noise resembles that of a hammer striking forcibly upon an anvil, and it is only surprising that they run as long as they do.

To meet the above-mentioned faults of electric clocks is the purpose of the device of my electro-magnetic escapement, of which I exhibited here my first model about two years ago, and which is, indeed, the only second system of time telegraphs that is new in its fundamental principle that has been invented in almost half a century.

drawing. D is a lever with an adjustable weight at F, and presses by means of the pulley, E, on its circumference and rests at the bottom of the cog, when the electro-magnet is not charged with magnetism. When in that position, as shown by the drawing to the left, two of the armatures are very near to the poles of the electro-magnet.

At the moment when the electric current passes through the coil, C, and the poles, G, become magnetised, the two armatures will be attracted and take their position right over the poles of the electro-magnet as shown by the drawing to the right.

The escape-wheel, A, fastened to the same axle with B has moved with it and lifted up the lever, D, and has in its movement gone so far as to allow the pulley, E, to glide over the point of the cog and keep its position, shown on the drawing to the right, until the electric circuit is broken again; then the poles, G, become demagnetised, the armatures are no longer attracted, and the wheels, A and B, move under the pressure of the pulley until it has reached the bottom of the cog. By this movement the next succeeding two armatures have taken their position shown to the left, again ready to be attracted at the next closing of the electric current. In this manner is produced, by alternately opening and closing the circuit, a step-like movement of A and B. You will perceive that the object aimed at to avoid violent checks of the armature is completely achieved. Another advantage of no less significance is gained, namely, that it is impossible for the escape-wheel to move without an extra provision, at any given impulse, more than one cog.

Before I show the application of my escapement to time telegraphs I will explain the manner in which I make and break the circuit by means of a weight clock, in order to transmit the time to the electromagnetic escapement. This current-breaker, fig. 3, I have found to be very effective. B is a metal disc fastened to the axle of the escape-wheel of a clock. It has platinum pins vertically upon its face. C is another smaller platinum disc fastened to the pin-bearing disc, *b* and *b'* are two springs with platinum terminations. The spring, *b*, rests on the platinum disc, while *b'* forms the contact with the platinum pins.

When the disc moves with the escape-wheel of the clock it will complete the circuit of the galvanic battery, whenever the spring, *b'*, comes in contact with one of the pins, and when the spring is removed from the pin the circuit is broken.

I found this current breaker fully to answer its purpose and to meet all the requirements. It prevents by means of friction all accumulation of dust and oxidation and keeps the contact surface bright.

The best clocks for making the contact for time telegraphs are undoubtedly those provided with a gravity escapement invented by Edmund Becket. Clocks with gravity escapements allow an increase in the weight of the clock to such an extent as is needed for a secure metallic connection of this contact-breaker without affecting perceptibly the impulse given to the pendulum.

I now come to a subject of less general interest, but of not less importance, that of real electric clocks, where the moving power of the whole mechanism is electro-magnetism only. I called such clocks in my paper two years ago more of a scientific curiosity than a useful invention; and yet some of the most prominent philosophers and mechanicians have devoted their time and genius to their construction to make them correct time-pieces. The first who constructed such clocks was Bain, about forty-five years ago. At present the clocks of Dr. Hipp seem to take the lead, but although he claims great accuracy for them, they seem not to sustain the claim in every instance. One small specimen of his clocks is exhibited in the window of Mr. Thomas Shaw, Ridge Avenue, above Ninth Street, of our city. In principle I think it to be a step backwards, as it is but a modified and improved clock of the Bain type.

There are three main difficulties in the way of making electric pendulum clocks a success.

They are, first, the variation of the strength of the electric current of galvanic batteries; second, the danger that the current-breaker will not make a sufficiently secure contact for the passage of the electric current, since the contact is made by the pendulum, which has not in all cases sufficient surplus of power to make a secure contact; and, third, the obstruction which the current-breaker offers to the pendulum in its oscillations. Therefore, electric clocks can only be a success when the above-mentioned difficulties are avoided. I think I have met the difficulties successfully by a clock exhibited here to-night, presently to be explained.

I shall first explain the current-breaker of my clock, and to show how far it differs from those employed up to this day I will introduce this explanation by a brief description of the current-breaker now in use at the astronomical observatory in Paris.

There the pendulum of the clock has two side-extending metal arms. Each of these arms is provided with three screws with platinum terminations. Three levers, separately movable, but in metallic connection, corresponding to the screws, will be either in contact with, or removed from the screws as the pendulum moves to and fro. The levers and the arms are inserted into the circuit of a galvanic battery and an opening and closing of the same, corresponding to the oscillations of the pendulum, will be effected. That the pendulum meets with a comparatively great obstruction in its movement by such a current-breaker cannot well be disputed, and yet the contact cannot be formed with a great deal of force to make it as secure as desired, since the levers have to be very light so that they will not obstruct the pendulum too much in its movements.

I now will show how I effect with a new device of a current-breaker a secure and firm contact, and yet at the same time allow the pendulum to follow the course of its oscillations without meeting with any obstruction. Fig. 4 shows a front view of my electric clock, and fig. 5 a side view, in which N is the pendulum and T, V and V' its current-breaker. You see an upright standing lever, U, with a weight, X, on the top. Near its fulcrum are two screws, V V', against the one or the other the lever will rest, if the pendulum is out of its vertical position to one side or the other. Two electric wires, S S', coming down the pendulum rod are in metallic connection with the two suspension-springs, S S'; both springs are fastened together at *e* by an insulated substance, and each of these suspension-springs is again connected with its corresponding spring, R R'. Now let the poles of the galvanic battery be connected with the springs, R R', and set the pendulum oscillating. If the pendulum has its present position, the lever, U, rests against the screw, V, and forms a metallic contact with the screw. The screw is connected with one of the wires coming down the pendulum rod from one of the supension-springs, and the lever is again connected with the other wire coming from the other suspension-spring, so that the electric current can pass through the contact made by the lever, U, and the screw, V. If the pendulum has its position on the opposite side, the lever will bear against the screw, V'. This screw has an insulating substance upon its termination that keeps the circuit broken. Thus, by the movements of the pendulum to and fro the lever, U, will bear against one or the other screw, and make and break the electric circuit. The fall of the lever from one to the other screw is so small that it needs very careful watching to perceive it. The contact formed proves to be secure. It is made with a great deal of force, since it is formed very near the fulcrum of the lever. You will observe that this simple contrivance of my current-breaker removes two of the principal difficulties which electric clocks have to combat with. It now remains to show how I made the impulse given to the pendulum for its movements independent of the strength of the electric current acting upon the electro-magnet of the clock. The springs, R R', are connected with the electro-magnet and inserted into the circuit of the galvanic battery. You see in the drawing fastened to the axle of the lever, D, that moves the escape-wheel, an arm, I. Against this arm, rests the lever, L, with its fulcrum at *q*. The extension of this lever touches the pendulum, while resting on the arm, I, when the pendulum hangs in its vertical position.

Now, if the pendulum is moved to the left, as it is shown in fig. 4, the lever of the current-breaker will bear against the screw, V, and close the circuit. The armatures nearest to the magnet are attracted, and the lever, D, that moves the escape-wheel is raised, and with it the arm, I, is moved, which in turn raises the lever, L. There it remains until the pendulum has taken its position to the right. Then the lever of the current-breaker drops against the insulated screw, V', and the circuit is broken, then the lever, D, suddenly drops down, moving the escape-wheel, while the lever, L, drops against the pendulum and the pressure of its weight gives the pendulum the impulse for its oscillations. This action of the mechanism is repeated as the pendulum swings to and fro. If we now consider that the lever is always lifted up to the same height, and its weigh' ... is not subjected to any changes, the power, acting upo the ... the pendulum to keep up its oscillations, must be the s... me at every impulse given, without regard to the attracting ... force of the electro-magnet. It will be seen that this ele... ctric clock makes a firm contact for the electric current t... pass; and that it

does not obstruct the pendulum in the course of its movements, and also that it makes the movements of the pendulum independent of the strength of the galvanic current. This, I think, embraces all the elements necessary for a true timepiece.

Some few words are in place regarding some details of the clock, to make the entire mechanism understood.

Two hard rubber plates, *g* and *g'*, are essential to insulate the metal plate, P, from the screw, Z, and the post, Q, to prevent the current from going directly through the plate, P, from Q to Q', in which case the current would escape the passage through the current-breaker, and the circuit would be continuously closed.

To avoid the passage of the current through the holes in which the pivots of the lever, U, move, a spring, *p*, is fastened to the support of the lever, pressing against a platinum pin, *i*, at the axle of the lever. The pulley, *f*, over which the suspension-springs, S S' are laid, is of hard rubber, to keep the springs insulated. 1 and 2 are two bars, also of hard rubber, which support the pendulum, and between which the two ends of the suspension-springs are fastened. The plates *a* and *a'* are of the same material, and are used to hold the suspension-springs in their proper positions.

THE BRITISH ASSOCIATION.

[*Specially reported for the* ELECTRICAL REVIEW.]

A NEW FORM OF ARC LAMP.

[Paper read before Section G, Monday, August 28th. By Prof. G. FORBES.]

PROF. FORBES stated that this lamp was specially devised for powerful currents—for lighthouse lamps, or projectors, where a powerful current was used, and where there was some difficulty in feeding the carbons. It had been found necessary under such circumstances to have the power not only of causing the carbons to approach each other, but sometimes to cause them to rub slightly, and that was a point not usually required in the construction of an arc lamp. At the same time, the arc lamp he held differed from others in this, that the point where the light came from was fixed, and did not vary in the consumption of the carbon. The two supports for the carbons were both connected with racks, and there were pinions mounted in the same axes, but insulated from each other. The size of these pinions was so regulated that the one carbon moved twice as quickly as the other, and therefore always kept focus, which was a necessary point in lighthouse illumination. A shunt current passes through a ring, which is really the armature of a Gramme machine. The main current passes through an upper series of coils, while the derived current from the armature passes through a lower series. The carbons, of course, are at first in contact, but as they wear away the resistance of the arc increases, the current diminishes in the main circuit and increases in the derived one, which goes in an opposite direction to the other, and the effect is utilised on a worm wheel, which turns to feed the carbons, so that the position of the light is always kept constant. The main circuit is continually tending, by the mechanical arrangement of the lamp, to pull the carbons apart, and the derived circuit to keep them in contact. If the current is too weak, the main circuit separates them a little further, so that the regulation is always kept constant.

Mr. Preece remarked that there appeared to be a special inventive effort just now in the direction of new systems of arc lighting. There seemed to be a great deal of novelty and ingenuity about that which Prof. Forbes had exhibited, and he hoped that it would be a success in practice.

A NEW HAND DYNAMO MACHINE.

[Paper read before Section A, August 25th. By W. H. PREECE, F.R.S.]

WHEN in Paris, I saw an extremely compact and useful dynamo machine. There are a good many in this room who have occasionally to appear before the public as lecturers, and there are also many who are engaged in instruction. Most of us require at times, in our laboratory and rooms, some convenient mode of producing a very powerful current. The only machine available for us is the small magnetic machine of the Gramme type, where a ring is rotating in the field of powerful permanent magnets. In this particular instrument, however, the field is produced as it is produced in ordinary dynamo machines, such as is used for the production of electric light. Owing to the peculiar construction of this chapel, I have been unable to fix the instrument (the maker of which I may say is Baron M. De Méritens) so that all can see it, but I have it in the hall, and I will work it so as to show you some of its effects. The armature of the machine is of the Paccinotti type—made of a series of flat plates serrated. The ring is furnished with projections, 16 in number, through which 16 wires, one for each, are brought to the commutator, which is similar to that used in the Gramme machine. The ring rotates in the field of an electro-magnet just as is done in the Gramme and Siemens. I have two men who will work the machine, and from the currents produced, which are brought here by means of two conductors, I hope to form a small electric light. The electromotive force when working at full speed is 70 volts, the resistance of the field magnet is four ohms, and the resistance of the armature is four ohms. The connection is such that either the field magnet can be put in as a shunt, or as a series in the ordinary way. Four men working it will produce a capital electric light, and one man a capital Swan or Edison light. Two men should, I think, be able to keep three lamps going. The price is only £15 without the mechanical construction, and the whole thing complete is one of the most convenient that could be used for very many purposes.

The first experiment with the machine was a total failure, owing apparently, as Mr. Preece explained, to some short-circuiting, which he hoped they would be able to remedy.

Mr. Taylor said that when last in Paris, he had looked about for some machine of this kind that would give a good current, and could be turned by man-power, and he had found only two machines that would fulfil these conditions. He had obtained one—a machine by Giaraud—and from what he had seen of it since he did not think that De Méritens' machine, as described by Mr. Preece, was any better. His Giaraud would feed a Swan lamp well with one man turning it. It was a magneto, not a dynamo. It had eight electro-magnets constituting the armature, made and unmade by passing between the poles of sixteen steel magnets. It could be made to give either direct or alternating currents. It would give an arc light very well as long as there was some one to watch the distance of the carbons. It was sufficiently powerful to melt fine iron wire. The price was 1,000 francs. He thought the weight was about 500 lbs.

A Member had understood Mr. Preece to speak of a hand dynamo as something of a novelty. He had made a very efficient dynamo some time ago for the Medical Congress with a permanent magnet resembling somewhat an Edison machine, which would work a Swan lamp very efficiently for surgical purposes. He could not give its resistance, but its price had been £25, complete with all the multiplying gear. It was much smaller and lighter than Mr. Preece's, but still sufficiently firm to stand without being fixed to the floor.

Mr. Ladd had had some considerable experience with hand dynamos as well as magnetos. He had himself introduced the first hand dynamo machine to that association at its Dundee meeting, when Sir Wm. Thomson was president. Since that time he had abandoned that principle altogether for what he considered a better one—to be found in the Gramme machine with permanent magnets. He thought that that had entirely superseded anything else that he had seen. He believed the dynamo principle good for large machines, but really not well adapted for a hand machine. The dynamo he had, however, heated a platinum wire of about 18 in. long, and that was as much as one man could do. In a Gramme machine one man could do the same thing very easily. He had found the best form of magnet to be of a circular form. If three magnets were put together for that purpose one man could do the work very easily. In the machine before them the enormous speed of the armature ought to produce a great effect, and it did, as shown by the sparks given; but, then, it was at the expense of three men. The machine reminded him somewhat of the machine by Giaraud, in Paris, a Ruhmkorff, where the disc was made to revolve between the poles of the magnet. But in that machine when a man was working it easily, directly the power was put on he was forced to stop instantly. He had made his machine feed two Swan lamps with the expenditure of one man-power.

Mr. Swan said that the hand Grammes had been very much restricted by the imposition of a very heavy royalty duty and their high price. He took it that the present machine was not hampered in that way. If he remembered rightly, the price of a hand-Gramme, including royalty, in England was about £40, whereas Mr. Preece's exhibited dynamo only cost £15.

Mr. Preece said that the price of the dynamo was 350 francs, and the mechanical portion was additional, costing say, another £5, so that they might put the whole cost of the machine as £20.

Lord Rayleigh said that the general question raised by Mr. Ladd, as between dynamo and magneto, was of great interest. There seemed to be some presumption in favour of the magneto for a small current, as being more easily available within wide limits. Still, he had always found the Gramme extremely convenient.

A Member said that from his experience he had found that for small currents the hand magneto was capable of producing greater effect than the dynamo. His magneto was very effective with a small Swan lamp. He had also wrought a heavy sewing machine by its means, there being a boy only to turn it; but it was all that he could do.

[The machine was here again experimented upon, this time with perfect success, two men turning the machine produced 3 lamps of full power.]

Mr. Preece said they would notice in the lamps that excessively pretty violet light which indicated the last stage of the lamp's existence. If the velocity of rotation had been increased, perhaps 10 times a second, or perhaps not so much, the three filaments of carbon would be broken with the strength of the current. The current was very nearly an ampère for each lamp. Hence, the three lamps were being wrought with an electromotive force of 70 volts, that gave them 210 units of power expended, units which he hoped would in future be known as Watts (applause). That was really ·35 horse-power. If they added to that 10 per cent. for the work consumed by the machine, they formed an expenditure of about ·4 of a horse-power in producing those three lamps, which was a very fair indication of the value of the instrument. He might add as to its weight, that three men had no difficulty in carrying it into the chapel. It could be used for the transmission of power, and for all experiments connected with the electric light, and to those who were in the habit of spending money in the acquisition of apparatus, he thought he could say that they would find the De Méritens machine exceedingly cheap.

ON ELECTRIC METERS.

[Paper read before Section A, August 30th, 1882, By C. VERNON BOYS.]

MR. BOYS exhibited an extensive series of models bearing on the subject of power-measuring in general, which might be applied to electrical measurement in particular. The general principle was applicable to differential metronomy, and all the apparatus were based on the same idea, though the application made to the special case of measuring differences of potential, was in one or two of the instruments exceedingly complicated. The fundamental idea utilised in the mechanism consisted in a wheel rotating in contact with a cylinder, but at an angle of about 30 degrees with the perpendicular cross section of the latter. The result was a transference of the rotating motion of the wheel into a longitudinal motion of the cylinder, if the cylinder was left free to move endwise. By a clockwork arrangement the wheel motion when the cylinder had reached the end of its path was transformed into a motion in the contrary direction, and thus the cylinder was forced to turn continuously within its field with an alternating to-and-fro movement. The applications of this mechanical principle, which Mr. Boys described as comparatively novel, were described as numerous and of wide range. One instrument, adapted as a differential electric meter, was spoken of by Sir William Thomson as novel and highly ingenious. The apparatus consisted of two small magnetised steel cones, revolving on separate spindles, point downwards, so that each spindle might be connected with a separate source of power. A small cross-piece of soft iron was hung between the cones, touching each of them with one end, and retained in position merely by the fact of the cones acting as magnets. When revolution was set up in the cones, the inventor showed that the cross iron remained always parallel to its original position if the two velocities were equal; but immediately that either of the cones moved more rapidly than the other, it was demonstrated that the angular displacement of the iron indicated with absolute accuracy the differential velocity of the spindles. Sir William Thomson, in remarking on the ingenuity displayed, stated that the latter instrument might be a valuable application in the measurement of potential differences between two electrical currents.

THE THICKNESS OF WIRE NECESSARY TO CARRY DIFFERENT ELECTRIC CURRENTS WITHOUT OVERHEATING.

[Paper read before Section G, Monday, August 28th, 1882, By Prof. G. FORBES.]

ONE would expect that if one wire would carry a current of one volt, then two similar wires would carry two volts. This is so if the currents are very far apart, but when the currents are near together we have to take into consideration the surface, from which radiation is continually taking place. Consequently, however likely it would seem at first sight that the current carried would be proportional to the section, as a matter of fact it is not so. I find by experiment that if there is a departure from the law of the square of the diameter then the law is that the current is almost proportional to the diameter of the wire. If you can carry a definite amount of current through a wire of a millimetre of thickness without heating it over a temperature of 150°, then if you want to carry a current twice as great through a wire you must have one of two millimetres diameter—*i.e.*, four times the section. This is a very serious matter in regard to the extension of electric lighting. The method of arriving at the law was by taking pieces of wire of different diameters, putting a trace of bees'-wax upon them and then by diminishing the resistance slowly so as to heat very gradually indeed, find the current necessary to melt the wax. Another very important law which is necessary for us to know in order to be able to change the type of dynamo so as to produce another which will give any desired electromotive force, is that when the wire is wound in coils so that the coils are the same size, then the strength of the current which is allowable is proportional to the square of the diameter of the wire—*i.e.*, to the section. In determining this law I used small coils in tubes closed at one end, and filled with water of a definite temperature, then the current was raised by changing the electrical resistance until the temperature was definitely increased, and the strength of the current was read off—this law being the result.

A NEW FORM OF GALVANOMETER FOR MEASURING CURRENTS AND POTENTIALS IN ABSOLUTE UNITS.

[Paper read before Section A, August 29th, 1882, By Sir W. THOMSON.]

THAT machine, which had been specially constructed for purposes of easy portability, consisted of a framework of needles supported on a sapphire cup by an iridium point, like the best arrangement for the support of the mariner's compass. For the laboratory he should prefer a silk fibre suspension wherever it is not to be carried about; but for the purposes of portability he preferred the arrangement he had mentioned, as it is almost impossible to make sure that such an instrument can be carried about without breaking the fibre. He had allowed the needle to rest on its point, and, as they observed, it might be given any amount of rough usage. The arrangement is placed on a three-legged stool and in a sliding trough cut in a block of mahogany. One of the feet is placed in a certain groove, and the other two slide outside. By means of this arrangement they got the utmost possible resistance to all motion or shakiness, and they had that attention to the geometrical principles involved in its construction with almost astronomical steadiness. This steadiness was the main feature of the instrument described. The great difficulty in potential measurement was, of course, temperature correction, because potential measurement involved a knowledge of the resistance of the coil. In the instrument before them it was not necessary to have a knowledge of the resistance of the coil, and the temperature corrections varied from about 1 to ·992 at 20°; that was, about 8 per cent. He might add that the wire which he used was of copper. German silver might be used, but the disadvantage of that was its less sensibility.

DISCUSSION ON DR. GLADSTONE'S PAPER ON SECONDARY BATTERIES.

(*Continued from page* 197.)

LORD RAYLEIGH said that the subject was almost a burning one, and a minute and thorough investigation of the chemical reactions involved in the working of such a battery would be the key to many of the difficulties that yet remained to be overcome.

Professor Lodge said that on one point Dr. Gladstone's experience had been in apparent contradiction to his. That point related to the possibility of reducing sulphate of lead when spread on the plates alone. There were perhaps theoretical reasons why one should expect sulphate of lead to be not readily acted upon; and because it was not a conductor one might expect the action to be to decompose either the water or the sulphuric acid. But he did not think it reasonable to expect that hydrogen would attack a non-conductor. On the other side the oxygen could unite with the lead plate and form protoxide—ultimately, however, peroxide—if not, as he himself thought possible though less probable, peroxide at once. At any rate peroxide did certainly form there as in a Planté cell, and as peroxide was a conductor some oxygen would be liberated. Then they would have $PbO_2 + PbSO_4 — H_2SO_4$. Then the PbO_2 would spread through the mass of a secondary action, and there would be a reduction of $PbO_2 + PbSO_4 + H_2O$. But at the other side of the cell nothing of that sort would go on. They would simply have the hydrogen liberated, and the sulphate of lead not acted upon. He had found that minium charged distinctly the best. It reduced more quickly, it oxidised more quickly than any of the other substances he had tried. Litharge came next, and reduced perhaps quite as well as the minium, though it did not peroxidise quite so readily; but he had found no change whatever in the sulphate of lead. He had put it on as a white paste, and thus it had remained, though he had tried it with two Groves and hand Grammes. Dr. Gladstone said that he had tried sulphate of lead, and had been able to reduce it. That was not his experience at all. If the sulphate was mixed with minium the minium reduced itself readily, but the sulphate was not acted upon.

Sir William Thomson said that his results corroborated those of Professor Lodge. He had taken two platinum plates with about one-eighth of an inch of sulphate of lead on bibulous paper between. He had left these with a considerable difference of potential maintained between them—perhaps 2¾ volts—for about six weeks or two months. The result was that the sulphate next the plate kept positive was peroxidised through its whole thickness. The other platinum plate remained perfectly white. Over about half of the plate indeed there was a discoloration, which might just possibly contain a trace of metallic lead. Certainly, if there was anything it was an exceedingly minute amount, and *practically* non-existent. It was highly important that such investigations should be pursued. The chemical theory of the working of these batteries needed a great deal of working at.

Prof. S. Thompson could also confirm Prof. Lodge's results. He would like to call attention to the fact that the earlier experiments of Planté and Faure bore out the same idea. By a process of alternately charging and discharging it was found that there was yet an accumulation of peroxide on the one side, and a spongy material on the other, of the cell. In forming his plates, Faure found it advisable to leave the battery to itself for a time, which might vary from a few hours to a few days, and that period of rest greatly improved the action. What took place during the period of rest? He believed that Dr. Gladstone's experiment threw some light upon that question: there was local action going on. At the point of contact with the lead plate, local action was producing sulphate of lead, which afterwards could be peroxidised, but there was no effect when a mere production of hydrogen was going on. He himself had tried many experiments. He could not agree that minium had the very best effect: his best results had come from the use of lead in a powder either by reducing minium or litharge at a low temperature, or else by precipitating it from either the nitrate or the acetate of lead. The reduced lead was a much better substance to work on as a preliminary substance. Another point in which he could confirm Prof. Lodge was as to how the action proceeded in layers. There was a plate of lead, and upon that a coating either of red lead or litharge, and so on. The peroxide formed close to the plate, and advanced right through till the whole was peroxidised, and the reduction went on in the same way. If they covered the plate with red lead, and so liberated hydrogen, action began not at the place where the liquid was exposed to the lead, but right inside between the red lead and the plates, and so gradually penetrated through the mass. This action took place, no matter whether the lead was taken pure as painted or plastered upon the plate, or whether it was packed. He had found when taking cells to pieces that wherever there was a place to which currents could not flow directly, there was sure to be a deposit of unreduced sulphate which was simply so much waste.

His own impression was that the very best form of secondary battery was that of Planté's accumulator of 1860, pure and simple.

Prof. Lodge had always thought it exceedingly desirable that the action should proceed straight outwards, beginning at the surface of the lead and going on, but he had never been able to get that done without great precautions. Action always began at the bottom. It peroxidised on the surface, proceeded to the bottom, and then crawled up the other side of the cell. After starting with a certain amount of sulphuric acid a great deal always got absorbed by the minium. When charged, however, all that acid reappeared. The electromotive force was always greater when charging than discharging. In the beginning of charging a Faure, they did not have a maximum electric force. But they put two metallic lead plates into a vessel of dilute sulphuric acid, and connected them with two Groves, their force was almost sufficient to stop the current; but if instead of clean plates they had them both covered with minium, the action was very much less, because there was not that oxygen and hydrogen layer which was pretty well concealed in acting on the minium.

Prof. Macleod asked if the sulphate of lead used in the cell might not be in such perfect contact as that which was formed on the plate by the action of the acid. He had tried a few experiments to replace the lead entirely by zinc, using a solution of sulphate of zinc and passing the current in such a way as always to make a deposit on the zinc plates. In that way he got a high electromotive force and a gradual dissolution of the free sulphuric acid.

Prof. Lodge said that that would give a very much greater amount of local action, and the plate become very much sooner coated.

Prof. S. Thompson said that in Faure's early experiments he used sulphate of lead before he hit upon red lead, and that he was able to excite by charging first in one direction, and then in another. It was not till he got red lead that he found he could dispense with the charge backwards and forward.

Dr. Gladstone said he was glad that such an interesting conversation had arisen from this matter, and also to hear that so many physicists were at present investigating it. He had no doubt that the mysteries of the chemical reaction would be fully illustrated; but there were still at present some mysteries that waited for solution. Prof. Lodge had objected to the statement that sulphate of lead was reduced by hydrogen. He was not sure that he had made it in his paper—but he had certainly made it in print before. Still, he did think, however, that it was reduced to a very small extent. In the early part of the investigation which he had made, when very little was known about sulphate of lead, he and his colleague had put sulphate on the two plates, and after passing a current between they had found, as they thought, a reduction close against the lead itself, so that it was difficult to distinguish between lead and reduced lead. On repeating the experiments with platinum plates, after chemical tests, they succeeded in getting what was to them satisfactory evidence that there was a certain amount of lead produced in the neighbourhood of the platinum, though not much. Prof. Lodge had written a paper in *Nature* on these experiment, and after it appeared he (Dr. Gladstone) had tried the experiment again, when it certainly did appear that the sulphate was reduced, though it was so closely in contact with the red lead that it was of course possible that the lead might have been got from the plate. Still he did believe that there was not merely a trace, but rather more than a trace of lead produced. The difference between the results of experiments might be that hinted at by Prof. Macleod. Sulphate of lead was a non-conductor, or nearly so, and under such circumstances one could hardly expect a reduction; but when sulphate of lead was produced close in amongst all the substances taking part in the operation, there was a general evidence that the accumulation on the positive plate was such that could not have been supposed to take place, the sulphate could not be reduced at all. If Prof. Lodge's view was true, it pointed to a very serious difficulty in regard to these batteries; but still he hoped that that difficulty did not exist to any great extent. As to the way in which the action took place, it was curious to see how the action spread from certain points. It gives them sometimes very singular appearances. It was necessary to bear in mind that good contact was necessary in these reactions, and however carefully spread with red lead some portions must have far better contact than others; there were often all kinds of irregularities in these plates. There might be a considerable amount of local action without reducing the electromotive force of each particular cell. He trusted these remarks and those with which they had been favoured by other speakers would draw attention to these points of controversy in connection with secondary batteries, and which were certainly of great importance.

DISCUSSION ON Dr. SIEMENS' PAPER ON A PRACTICAL SYSTEM OF ELECTRIC UNITS.

(*Continued from page* 196.)

Sir Wm. Thomson said there were one or two points upon which he should like to offer remarks. This was an explanation of so-called practical system that was proposed. He had had great, anxious, and careful discussion with Prof. Clausius on this subject, and he agreed with him that it was impossible to carry out the practical system to apply to the magnetic pole and the magnetic field in accordance with the plan based on that system so far as the list of items included by Dr. Siemens was concerned. In that list each of the practical units was connected with the other in a very simple and definite manner. Dr. Clausius had, however, given his adherance absolutely to the C.G.S., and nothing less for the magnetic field, and, therefore, also for the magnetic pole. Going beyond the list of units which their president had given them, they must consider in the next place the question of velocity. If they were to include the measurement of the velocity in the so-called practical system, in order to make that system coherent, then their unit of velocity would be 10^9 centimetres per second, or 10,000 kilometres per second. The definition of the practical system was this—it was a system in which every unit should be of convenient magnitude. That was the first condition, and the second was that every unit should have a name. Now, he did not think that 10,000 kilometres per second was a convenient practical unit for measuring velocity or any velocity in terrestrial engineering. That opinion he thought would be unanimous, and therefore they failed when they attempted to extend the practical system so as to include velocity. But it was necessary to extend velocity if they wanted to make scientifically coherent their definition of quantity and of the magnetic field and pole. They must, then, be consistent. But would it be practically convenient to reckon the velocity of a machine in terms of 10^9 times the earth's quadrant? Certainly not. The intensity of the magnetic field, according to the practical system, would not be in the force of an ampère at a distance of a centimetre, but the force of an ampère at the distance of 10,000 kilometres. Therefore he said it was impossible, granting the earth's quadrant was not a convenient practical unit of length to grant that 10,000 kilometres was a convenient unit of velocity. Taking this for granted, it was impossible to carry out the practical system consistently with an absolute method of measurement. What was the use of two methods at all? He had gained some particle of wisdom, he thought, in the course of 30 years, and the original suggestion of Clerk-Maxwell, giving the names of distinguished men to these various units, scarcely commended itself to him. But if there must be a practical system, let them at least give these names to convenient lengths of unit. Nothing could be more convenient than the C.G.S. in magnitude. But for the magnetic pole it was suggested that the terrestrial magnetic force at the equator should be one of unity, that is, the horizontal component of the terrestrial magnetism here is ·17, and therefore the component is ·44, a little less than one-half the unity. When they come to speak of magnetic force, the range of field was from 20 to 3,000, just the most convenient scale that they could have, because the strong steel magnitude did not go beyond 3,000 of the C.G.S. units. The most intense field they could possibly get was about 14,000 C.G.S. Nothing could be more convenient than these numbers to use, from 1,000 up to 2,000 or 3,000. His own proposal had simply been to add the name of Gauss to the previously existing units for the unit magnetic field, and Weber for that of magnetic pole.

Dr. Clausius said that the British Association had done a good work in composing the practical cycle of electrical units. All the units as at present presented in Dr. Siemens' paper were consistent, and could be suitably and algebraically expressed by the use of symbols of *p g* and *s* for the unit of mass, unit of length, and unit of time respectively. The name of Weber for the unit of magnetic pole, which he had proposed, had been omitted from the Paris congress. Sir William Thomson wished to change the definition of a Weber to that of absolute unit of magnetic pole ten times greater than his proposed Webers. He was sorry he could not accept the suggestion. They would then have no more a logical system, but a collection of units arbitrarily chosen. Sir William Thomson had said that the Weber was too great for practical use. But the Farad was also too great, so much so that they frequently used the term micro-Farad, but notwithstanding it had taken firm root. He would beg the section, and particularly Sir William Thomson, not to adopt what he had proposed. This system had been adopted by the Paris congress and by all peoples because it was good and logical; but if they received now into their system a unit which was not consistent with the others, then they would destroy their own beautiful work.

Professor Everett said that they ought not to introduce any unnecessary names. They could speak of the C.G.S. unit of pole and field. Unless the name came to be so frequently used that the C.G.S. became stereotyped, he did not think it expedient to endeavour to form a second thoroughly consistent and logical system to run parallel to the C.G.S. He thought Dr. Clausius was exacting too much from the practical system, which was devised to give units of convenient magnitude. He thought they might conveniently and with advantage add to the names of Ohm, Volt, Ampère, Coulomb, one or two others for practical use, but in such proposals he would not screw his logic-screw too tight in regard to consistency of unit. Although they knew the Ohm to be in one sense a velocity, it did not forbid them to use an earth-quadrant per second as a measure of mechanical velocity. If they admitted that Dr. Siemens was consistent enough, because taking the whole of the proposed units to begin with, they could express the whole of them in perfectly definite and logical terms of the C.G.S. unit system.

Mr. Preece was bound to confess, from the practical point of view, that there was an enormous advantage in having the unit of measurement of any kind associated with a name. The name conveyed the idea of dealing with something definite. They had a complete fixed notion in their mind associated with such names, for instance, as Ohm or Volt; but when they began to talk of the C.G.S. unit of quantity they got dreadfully mixed and confused. There was no greater boon than these names to practical men, as witness the rapidity with which they had been adopted. At Paris, in October last year, it was decided that the Ampère should be added to the list of units, and by the end of the year it had been adopted by all practical men. One term which had been suggested to this meeting of the association was much wanted, and he believed it would be used as rapidly as the Ampère, and that was the Watt. He had suggested the name himself, though he had applied it to a different unit from that which Dr. Siemens proposes. His unit was 1,000 times greater than Dr. Siemens'. To show the necessity for a name he need only speak of the large number of names that were at present in use for the same unit. It was called by very numerous names by authors and in books. Look at the terms, for instance, foot-pounds and horse-power. If there was one more abominable term than another it was horse-power, because it was never known in what terms horse-power was spoken of, whether nominal or indicated; and whether it was one or the other, people were just as wise as they were before.

Let them hope that horse-power would soon disappear. They also used another unit, the Kilogrammetre, and also the French horse-power, or *Cheval de Vapeur*. The necessity for the Watt, as Dr. Siemens proposed, was shown by the fact that electricians had begun to speak of Volt-Ampère, which in future would be known as the Watt. They would be quite contented to leave the terms Gauss and Weber to the contests of such giants as Sir Wm. Thomson and Dr. Clausius. They were not wanted practically. They could do without the names. They did want, however, a Watt and a Joule, for the unit of heat was as familiar as a household word. He could prophesy that it would not be six weeks before the Watt was used as a unit. Horse-power would then be expressed as 746 Watts, and they could adopt, if they chose, the Kilo-Watt, which would be a very useful practical measure.

Lord Rayleigh said that the section could not be nearer its useful functions than it had been to-day. What he had been particularly struck by was the necessity for the use of the Watt being shown by the fact that the term Volt-Ampère had come into use. He believed that the most important suggestions of the president would lead to no real difference of opinion. Everybody was willing to adopt the Watt and the Joule, and the only difficulties arose over the comparatively more abstract questions of the intensity of pole and unit of magnetism. He did not know whether practical men really did not require to use these terms, but he believed that before long their use would become a greater necessity than at present; but in the meantime they were not so urgent as the other terms.

Sir William Thomson said he agreed with Dr. Clausius that they ought to be absolutely logical to the very end. Prof. Everett had taken the centimetre for unit of length. Then the magnetic pole would be ·1 instead of 10^8, and the unit of magnetic field would be ·1 again. Therefore he could not agree that this was a thoroughly logical system; they got to grief at the very first step in the attempt to get a more coherent system. Could it be convenient to use seven million times the greatest field possible as obtained from soft iron and magnets in the practical system? Whatever they used for practical purposes must be of practical and convenient magnitude of field.

Prof. Everett would withdraw his recommendation. He did not see that there was such a pressing necessity for new units for either field or pole.

Dr. Siemens felt obliged for the satisfactory views which had been expressed regarding the two points to which he had attached the greatest practical importance, that of the Watt and the Joule. With regard to the other units of magnetic field and magnetic pole, he did not see how they could introduce them at all as distinct from the C.G.S. He agreed with Professor Everett, that it was much better to leave them entirely out, and not give any name to them. But he also agreed with Dr. Clausius, that the quantity which at first sight is inconvenient, need not deter them from including them in the practical system. They had already an incongruity in the Farad. The Farad was a very inconvenient unit; so that they spoke of micro-Farads, and in the same way they could speak of micro-Gausses. But to go out of the practical system would destroy the usefulness of that system entirely; if they could not reckon upon the Gauss and Weber as an integral and consistant part of that system, they must leave them out of consideration entirely. After all, though 60 millions of miles seemed an enormous velocity, yet they had not to realise it; it was only a conception; it did not occur often in their considerations. To begin with, the electric pole only came to be of importance in more scientific investigations of their electric machines. For ordinary purposes these practical units were all that were required, and it did not convey any great objection to his mind that it involved a velocity exceeding that of a railway train, which did not exceed the velocity of light and radiant energy; therefore it was a very ordinary velocity after all. (Laughter). Hence they need not stand aghast at adopting that in composing their unit. And as to its value in the practical system, he did not think that there need be much inconvenience in dealing with the unit of magnetic field, which was 10,000 times greater than the one commonly in use. The use of the Watt and the Joule would soon become familiar, and did very much in practical discussions and conceptions.

On the suggestion of Lord Rayleigh, a very hearty vote of thanks was given to the President by the section for introducing his paper, which had lead to such an important and interesting discussion.

A NEW MODIFICATION OF THE DRY COLUMN WHICH AVOIDS DISSIPATION AND YIELDS CONSTANT TENSIONS.—L. Palmieri.—The column is piled up in a glass tube the inside of which it nowhere touches. The upper pole is not connected with the metal ring which surrounds the glass tube, but the screw which presses the column together from above passes through a brass triangle, which is secured by three silk cords drawn down to the pedestal of the tube. In damp weather the cords must be dried.—*Wiedemann's Beiblätter.*

ON THE IGNITING POWER OF RETARDED DISCHARGES.—By W. Holtz.—The author caused equal quantities of electricity to be discharged with equally retarding resistances, and found that the igniting power depended essentially on the situation of the resistance, being greatest when the [illegible] were immediately adjoining the spaces traversed [illegible]ks.—*Wiedemann's Beiblätter.*

THE ELECTRICAL ILLUMINATION OF THE THÉÂTRE DES VARIÉTÉS.

THE electric lighting of the large boulevard theatres at Paris presents a special difficulty, which is partly owing to the almost impossibility of finding in their neighbourhood a locality suitable for installing a machine of sufficient power. Accumulators have just given an elegant, simple, and practical solution of this problem. The system established at the Théâtre des Variétés since the 1st of September is operated regularly and contributes moreover to the success of this theatre, of which it constitutes an attraction, if not comparable, at least equivalent to that produced by the magnificent company of which Madame Judic is the star.

This illumination, made exclusively by incandescent Swan lamps, is composed of 205 lamps of two Carcels and of 60 others of a smaller pattern, arranged upon the footlights.

The electricity necessary for these 265 lights is furnished by an Otto gas-engine of 12 horse-power, working three Siemens dynamo-electric machines, of the pattern D', excited in derivation. These machines serve to charge Faure accumulators during 20 hours daily, which discharge themselves during the performance through the 265 lamps, which would require, without this employment of accumulators, an engine of 50 horse-power. The charging machines, as before mentioned, work for 20 hours per day, with two cessations of two hours, one after the performance, the other in the day about noon.

The current produced by the machines is divided amongst the three excitation circuits, and the seven series of accumulators connected also in derivation. (*See* the diagram.)

Each of these series is composed of 33 Faure accumulators of the 60-kilogramme pattern, containing 42 kilogrammes of active matter (reduced lead and lead oxide) in each element.

The 231 elements weigh, therefore, about 14 tons, and contain nearly 10 tons of active matter.

The electric energy stored in the accumulators is greater than that which is consumed during the performance, and one would be able without inconvenience either to add new lamps or diminish the time of charging.

The current furnished by each machine is regulated by altering a variable resistance, placed in the excitation circuit, which varies the intensity of this current and, consequently, the magnetic field and electromotive force of each machine These resistances are indicated upon the diagram at R_1, R_2, and R_3.

During the representation the dynamo-electric machines continue to operate, but the current which they produce is added to that which leaves the accumulators to supply the 265 lamps. The intensity of the current furnished, when all are normally lighted, is 350 ampères. Of these 10 serve for the excitation of the machines and 340 for the lamps. The production of this current is expressed thus :—

Three machines in derivation (28 ampères per machine) ...	84
Seven series of accumulators (at about 38 ampères per series)	266
Total	350

The lamps are disposed in four distinct groups branched upon the two principal conductors, which are connected with the machines and with the accumulators. Each of these groups is governed by a resistance series, operated by a commutator. By introducing a resistance more or less great into the circuit of each of these groups it augments or diminishes the intensity of the light, which [illegible]ows all the scenic effects of day, twilight and night to [illegible] introduced as with gas; better, in fact, for complete da[illegible]ness is more easily obtained, as it is necessary for this t[illegible] extinguish gas and then relight it, which is a complicated process.

Upon the diagram is shown the mounting of the groups of lamps, and the resistances A, B, C, D, which act as governors; these resistances are placed upon the left side of the stage.

The resistances, A, govern the lamps of the house divided into 20 groups of three lamps each; the resistances, B, govern the doorways, &c.; the resistances, C, the vestibule, corridors, and the chandelier; and, lastly, the resistances, D, govern the 60 lamps of the footlights, composed, as we

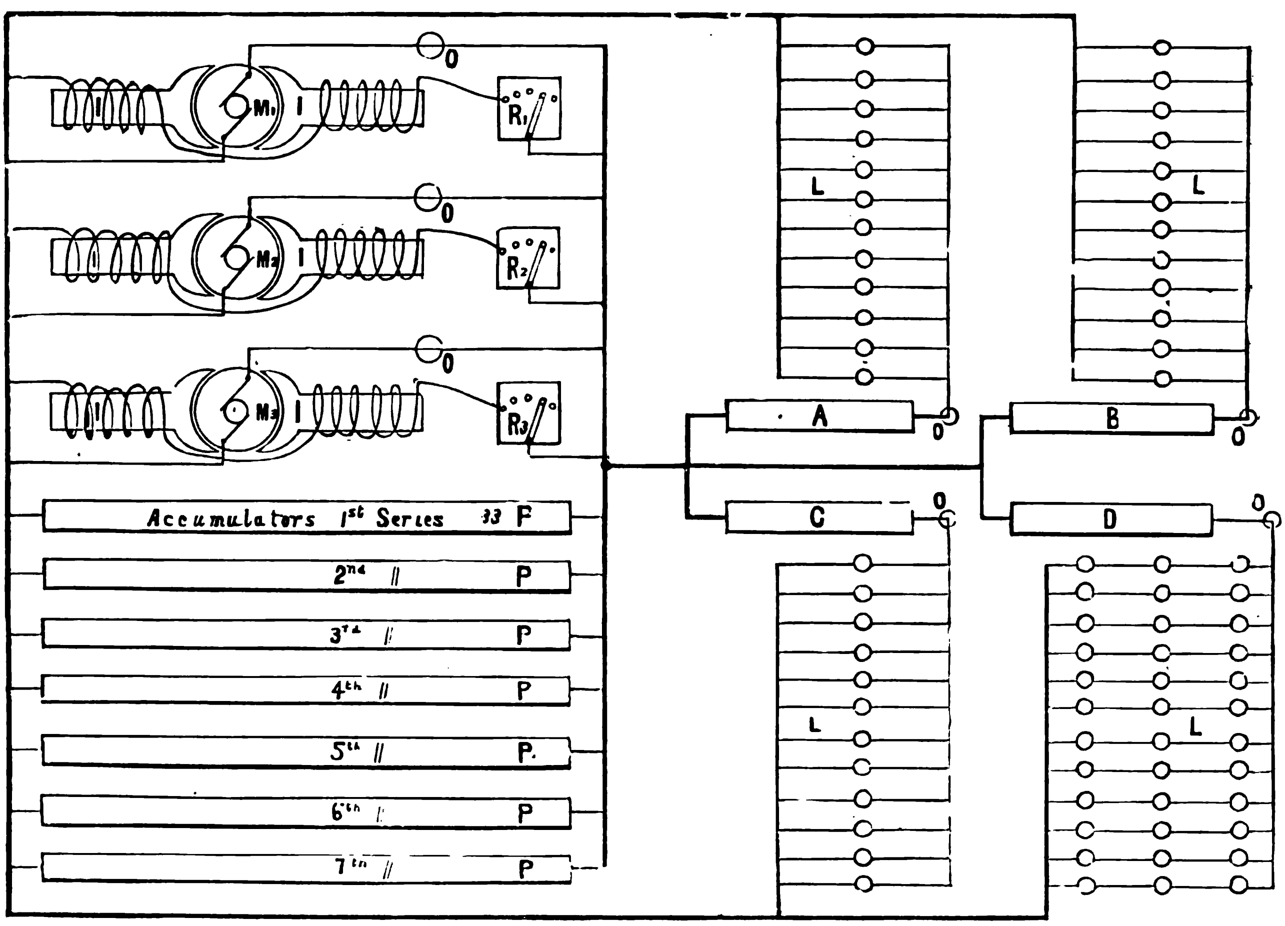
have said, of 60 lights of small pattern, disposed in 20 rows containing each three lamps in series.

The installation also comprises galvanometers to measure the current furnished by the machines, commutators for removing the machines from the circuit, the accumulators or lamps which are to be extinguished, &c., and all the things of which one can easily divine the place and the function.

The effect produced is magnificent, and the temperature of the house considerably lowered, as it was easy to foresee. As for steadiness, it is in every respect absolute, the machines only furnishing about one-fifth of the total current, the accumulators form a fly-wheel, if we may use the term, of every kind which would appertain to the installation of an engine of 50 horse-power.

It is worthy of remark, besides, that it is by burning gas that the electricity consumed in the theatre is produced; this fact has a great signification.

In conclusion, this installation, the first, we think, of this importance, made hitherto by the aid of accumulators and incandescent lamps, constitutes a great and legitimate success. The example which we have just quoted will not be slow to find imitators, and will contribute more to the development of the application of electricity than the fine promises and exaggerations which accompanied the *débuts* of the accumulator of which we record to-day the magnificent results.



which destroys all variation which would tend to be produced in delivery.

Owing to the grouping of all the apparatus in derivation, the electromotive force employed is only about 70 volts, which removes all risk of accident.

Safety-wires, judiciously distributed, interrupt automatically the circuit as soon as the intensity in any given branch of the distribution attains a dangerous degree. One machine or even all the machines may be arrested at a given moment without the extinction of the light or the slightest danger to the machines arrested, for the safety-wire will break the circuit before the machines have had time to heat dangerously. The series of accumulators grouped in derivation have an internal resistance small enough to maintain the lamps without the assistance of the machines; one would therefore be free to remove these altogether. All the installation only occupies a comparatively restricted space in the basement of the theatre, and every disposable corner has been utilised to lodge the accumulators, therefore it does not present the regular aspect of our diagram, which only demonstrates the principle.

This application presents a real interest in this way, that the accumulators are there in their true place and render possible the employment of electricity where local circumstances would have proscribed it by reason of the difficulties

Explanation of the Figure.

M_1, M_2, M_3.	Dynamo-electric machines of the Siemens pattern D^2, excited in derivation.
I, I, I.	Inductors of the machines.
R_1, R_2, R_3.	Rheostats for the regulation of the excitation of the machines.
P, P.	Seven series of accumulators, containing each 33 elements in tension.
L.	Lamps divided in four groups.
A, B, C, D.	Resistances governed by hand commutators for altering the luminous power of each group, the functions of each having been already explained. The lamps in the groups A, B, and C are all disposed in derivation; those of the group D are connected in series of three, and are of a very small pattern.
O.	Commutator.

THE NEW CHANNEL STEAMER.—On Monday night experiments were made with the electric light on board this vessel while she was lying in the dock at Dover with the most satisfactory results, the experiments attracting a large number of people on the quays.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE TELEPHONE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—"Quousque tandem abutere, 'Injustice,' patientiâ nostrâ?" is a quotation which seems to be a very apposite beginning of comments on the communication of "Injustice," published in your excellent Review of 9th inst.

In my letters to you I had not the cool impudence to set myself up as a judge of the justice of the decision by Mr. Justice Fry, the eminent judge in chancery, nor have I the presumptuous audacity of "Injustice" to intimate that "The court was unable to appreciate questions of electrical science," and I leave "Injustice" to sit as the Judicial Committee of the House of Lords to revise Mr. Justice Fry's decision. The words "blissful ignorance" in my letter in nowise referred to the estimable Sir Frederick Bramwell.

I do not deny that Mr. Justice Fry used the words as quoted by "Injustice," viz., "I think that the true meaning of the claim which I have just read is the union of a tympan or diaphragm capable of vibrating under the sound waves with an electric tension-regulator *having the quality* which I have *just* described"; now, *the* quality just described by Mr. Justice Fry is that of *resiliency* alone, not the three *qualities* of *compressibility* and *semi-conductiveness* and resiliency, and as "Injustice" attempts to lead me to think, thus deliberately committing a contemptible and disgraceful malversion of Mr. Justice Fry's very clear words. I no doubt erred in using the words, "that Reis's transmitter combined a diaphragm with a tension-regulator," as a quotation from Mr. Justice Fry's very lucid decision, but the fact is indisputable that Mr. Justice Fry did *think* so, and it necessarily follows from his judgment that "the essential requisite of Edison's invention is the combination of a vibrating diaphragm and a tension-regulator," and that the Hunnings' transmitter did contain such a combination, and was therefore an infringement of Edison's.

Mr. Justice Fry did say "such a tension-regulator as Edison described has been discovered in Reis's instrument," and, surely, if such a tension-regulator, in combination with a vibrating diaphragm, had been proven to have been discovered by Reis, Mr. Justice Fry could not have overlooked that fact, dealing with the prior publication of Reis's invention; and surely he would have decided the Edison patent to be void on that account. It is, then, clear as day that words used by me erroneously as a quotation from Mr. Justice Fry's decision are not "contrary to the sense of that decision," but are in perfect accord with it.

The decision of Mr. Justice Fry is that the combination of a tension-regulator with a diaphragm is secured to Edison by his patent, and the necessary conclusion is that Mr. Justice Fry "did not think it had been established that Reis's transmitter combined a diaphragm with a tension-regulator."

I beg leave to remark that correspondents who use a fictitious name are generally expected to be more courteous in their expressions than those who write over their own names.

I now dismiss from my memory the literary labours of "Injustice" with another quotation from the same author cited at the beginning of this communication—"Ad quem finem effrenata tua audacia sese ferebit?"

September 13th, 1882. JUSTICE.

ELECTRICITY APPLIED TO WARFARE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Allow me, through your paper, to make a suggestion (which, as far as I am aware, is entirely novel and original) regarding the above.

The importance to be attached to high speed in torpedo boats cannot, of course, be overrated, and to attain this every exertion is made to combine lightness with strong engine power; would it not, therefore, be an advantage to couple to the engine a dynamo machine (which could also be used as an electric motor), and, whilst not actually fighting, to use all spare power, or if necessary the full engine power (the propeller shaft being disconnected), to run the dynamo and fill a large accumulator with electricity, so that when manœuvring or making a dash the power of the accumulator might be used by the motor and extra assistance given to the engine?

It would, it appears to me, often be of incalculable advantage in warfare to be able to produce for a short time such an extraordinary high speed as could be made with such an arrangement, an arrangement capable, perhaps, of concentrating the engine power of five minutes into one. However, having made the suggestion, I leave it to wiser heads to pass a definite opinion on its practicability, and should be glad to know your own opinion or the opinions of such of your readers as may be interested.

Yours obediently,

C. SCOTT SNELL.

Culver Park, Saltash, *September 11th.*

SECONDARY BATTERIES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your issue of September 9th you draw attention to a "new process for the rapid formation of secondary couples with plates of lead," communicated by Monsieur Gaston Planté to the Académie des Sciences in Paris, on the 28th of August last, consisting of the roughening of the surfaces of the lead plates by nitric acid.

Without in any way desiring to detract from the discoveries of that most eminent man, to whom the first honour is due and should be ungrudgingly rendered by all who have worked upon his original ideas, it is nevertheless right for me to state that the principle of roughening the lead plates was very fully worked out by me last year, and is thus described in my patent specification of September 10th, 1881. The roughening by nitric acid being one of the most natural "chemical processes" is obviously therein referred to.

Extract, page 3, lines 10 to 19:—"The plates may be formed of perforated lead, or of lead cast with holes, *a*, either plain or with flutes, corrugations, indentations, shelves, or projections, *b*, in or on to which the material, *c*, already prepared or to be rendered active can be packed or placed. *The plates of lead may also be roughened on one or both sides by means of suitable tools, whether by pressure or striking, or by any chemical or metallurgical process giving an equivalent result in such a manner that to a suitable depth on each side of the plate a spongy layer, or projecting points or surfaces, are produced,* which are either suitable for retaining the material hereafter to be made active or *for obtaining a more rapid formation of the plates if used without such packing.*"

Your obedient servant,

JOHN S. SELLON.

Sydenham Hall, *September 11th*, 1882.

THE LANE-FOX INCANDESCENT LAMP.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I observe in your report of the meeting of the Devon and Cornwall (Brush) Electric Light and Power Company (Limited) that a shareholder (Mr. Tyler) stated that while the company's prospectus said that they had the *exclusive* right to the Lane-Fox incandescent lamp, he found that a general licence of a *prior* date belonged to the British Electric Light Company.

I think it right to say (because I negotiated the agreement with the British Electric Light Company at Mr. Lane-Fox's request) that he not only gave a free licence in July, 1881, to that company, but also paid them £5,000 in addition, for the liberty of dealing with his remaining rights. This licence is still in full force, and the British Electric Light Company have the complete enjoyment of the patents in Devon and Cornwall under that licence, as well as of the rest of the United Kingdom. [illegible] is stated by Mr. Tyler, the Anglo-American Brush [illegible] [Com]pany have

sold any exclusive licences in this country of the Lane-Fox patents referred to, it is for the directors of that company to deal with the special responsibility which they have undertaken in so doing. I am, Sirs,

Yours faithfully,

CHARLES T. BRIGHT.

31, Golden Square, W., *September 12th*, 1882.

THE LATE MR. J. B. LINDSAY AND HIS ELECTRICAL IDEAS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Following up the letter I sent you last week about "Telegraphing without Wires thirty years ago," I think I cannot do better than give you a few extracts from one of the local newspapers about this J. B. Lindsay's electrical doings as told by himself and others half a century ago. The undernoted advertisement, newspaper notices, and letters as then printed, I trust will be of special interest to many readers of the Review as illustrative of the beginnings of the electric light at that period in this out-of-the-way part of Britain. The words then used seem as if they were intended for to-day. This remarkable man died a number of years ago, and so failed to see the great bridge-like gap which has separated his small and unsteady light from the present splendid carbon suns and soft 5-candle lamps.

I am, obediently,

G. LOWDON.

Dundee, *September 11th*, 1882.

The following appears in the *Dundee Advertiser* of date April 11th, 1834, as a paid advertisement :—

J. B. Lindsay resumes on 14th April, 1834, in South Tay Street, Dundee, his classes for cultivating the intellectual and historical portions of knowledge. In a few weeks hence a course of lectures will be formed on Frictional, Galvanic, and Voltaic Electricity, Magnetism, and Electro-magnetism; the battery, already very powerful, is undergoing daily augmentation; the light obtained from it is intensely bright and the number of lights may be increased without limit; a great number of wheels may be turned, and small weights raised over pulleys. Houses and towns will in a short time be lighted by electricity instead of gas, and heated by it instead of coals; and machinery will be wrought by it instead of steam, all at a trifling expense. A miniature view of all these effects will be exhibited, besides a number of subordinate experiments including the discoveries of Sir Humphrey Davy.

A notice as it appears in the *Dundee Advertiser* newspaper of date August 7th, 1835 :—

ELECTRIC LIGHT.—Mr. Lindsay, a teacher in town, formerly lecturer to the Watt Institution, succeeded on the evening of Saturday, the 25th July, 1835, in obtaining a constant electric light. It is upwards of two years since he turned his attention to this subject, but much of that time has been devoted to other avocations. The light in beauty surpasses all others; has no smell; emits no smoke, is incapable of explosion; and not requiring air for combustion can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly calculated for flax-houses, spinning mills, and other places containing combustible materials. It can be sent to any convenient distance, and the apparatus for producing it may be contained in a common chest.

This letter appears in the same newspaper under date Dundee, October 30th, 1835.

ELECTRIC LIGHT.

SIR,—As a notice of my electric light has been extensively circulated, some persons may be anxious to know its present state and my views respecting it.

The apparatus that I have at present is merely a small model, it has already cost a great deal of labour and will yet cost a good deal more before my room is sufficiently lighted. Had circumstances permitted, it would have been perfected two years ago, as my plans were formed then. I am writing this letter by means of it, at six or eight inches distant, and at the present moment can read a book at the distance of a foot and a-half. From the same apparatus I can get two or three lights, each of which is fit for reading with. I can make it burn in the open air or in a glass tube without air, and neither wind nor water is capable of extinguishing it. It does not inflame paper nor any other combustible. These are facts.

As I intend in a short time to give a lecture on the subject my views on the further progress will be unfolded then. A few of these, however, may be mentioned just now.

Brilliant illumination will be obtained by a light incapable of combustion, and on its introduction to spinning mills conflagrations there will be unheard of. Its beauty will recommend it to the fashionable, and the producing apparatus, framed, may stand side by side with the piano in the drawing-room. Requiring no air for combustion, and emitting no offensive smell, it will not deteriorate the atmosphere in the thronged hall. Exposed to the open day it will blaze with undiminished lustre amidst tempests of wind and rain, and being capable of surpassing all lights in splendour it will be used in light-houses and for telegraphs. The present generation may yet have it burning in their houses and enlightening their streets. Nor are these predictions the offshoots of an exuberant fancy or disordered imagination, they are the anticipated results of laborious research and of countless experiments. Electricity, moreover, is destined for mightier feats than even universal illumination.

(Signed), J. B. LINDSAY.

IMPROVEMENTS IN ACCUMULATORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—My anonymous opponent appears again in the number of the ELECTRICAL REVIEW for the 2nd of September, with reference to the subject of the storage power in the *modified* accumulators. With the method of exposition of facts and of discussion which he adopts, he would apparently prove himself to be correct; allow me, therefore, to display clearly the matter in its true light.

In the number for the 15th of July last of "Annales d'Electricité" I stated that an accumulator (modified), containing 8^k 100 of minium and 8^k 800 of lead, gave for 6 hours 30 minutes a current of 13·33 ampères, and for 9 hours 30 minutes following a current of 13 ampères; and, lastly, for 4 hours and 10 minutes the current fell regularly from 13 to 8 ampères. (There was one omission as regards the duration of the 12 ampère current; this duration was 1 hour 25 minutes; and the total ampère hours ought to be modified in consequence, this fact is otherwise of no importance.)

To estimate the work, I adopt the formula $Tr = \frac{E\,I}{g}$, in which I substitute E by 2·15, g by 10, and I by 13, without remark, except as regards the intensity of the current.

It suits my anonymous opponent to make me hold that, even after the explanations contained in my previous letter, the electromotive force is constant. This is a small satisfaction, which I can grant him, being quite certain that it will not mislead any one, not even himself.

The question is this: Is the value of the electromotive force adopted, viz. 2·15, an exaggeration? This is the point. If so, what should the figure be?

I would remark that the first intensity, 13·33 ampères, lasted 6 hours 30 minutes, and the second intensity, 13 ampères, 9 hours 30 minutes, and that by adopting for these two intensities alone (the remainder being neglected) the mean electromotive force, 2·15, I arrive, nevertheless, at 20·300 kilogrammetres per kilogramme of active matter. It must be noticed, however, that during this discharge the external resistance remained unchanged.

Whilst, in the quasi-official experiments made by Messrs. Tresca, Joubert, Pothier, and Allard, the electromotive force of an ordinary Faure battery was 2·165 at the commencement; after repose, with a current of 16·37 ampères, at the time of the experiment, the current had fallen to 11·49 ampères and the electromotive force was 2·057.

Thus, a diminution of current of five ampères corresponded to a diminution of electromotive force of 0·108 volts; according to this what would be the loss of electromotive force for a diminution of one-third ampère after 16 hours in the experiment of which I have given the result? And what initial force ought I to have chosen? I do not think that I have exaggerated by adopting the figure 2·15 as the mean, especially if we do not wish to ignore that the discharge was not complete, and I am persuaded that it will appear sufficiently justified in the eyes of impartial readers.

My opponent wishes, moreover, not to lose sight of the fact that the ordinary Faure pile was not used, but an apparatus in which I consider that efficiency is decidedly increased, as well as the currents rendered more regular during the greater part of the discharge; *this* should not *be overlooked.*

My opponent, moreover, appears to think that I only calculate as active matter the peroxidised plate; he affirms it for the second time, and he returns to it anew at the end of his last critique.

Now, I said at first that the apparatus tested contained 8^k 100 of minium and 8^k 800 of lead, and that the minium constituted the active matter. To every person who knows what a Faure accumulator is, that means that the lead plates forming the support weighed 8^k 800, and that one had applied to them 8^k 100 of minium destined to become the active matter. Admitting that there was room for

doubt after my first exposé, that became impossible after my last reply, where it is said that the accumulator tested by Sir W. Thomson "contained 5k 700 of plumbic matter, that is to say, of lead forming the supporting plates and of minium, the weight of this latter was about 3k 500 after the transformation into spongy lead upon one plate, and into peroxide of lead upon the other; this is what constitutes the active matter."

It seems to me, Gentlemen, that after this simple exposé, no doubt can remain in an unprejudiced mind.

My opponent further reproaches me with taking account neither of the weight of the receptacle nor of that of the liquid. I answer that I have intentionally compared in the same manner results furnished by the weight of plumbic matter and of active matter in different experiments, made by different persons, without taking account, in any case, of accessory matter; these results are, therefore, comparable amongst themselves; the weight of the receptacle has not, in fact, any value when one is dealing with accumulators intended for lighting, and the weight of the liquid is almost proportional to the volume of the accumulator. I possess, moreover, receptacles weighing 300 grammes into which one can introduce 35 kilogrammes of plumbic matter, of which about 17 kilogrammes are active matter and five to six kilogrammes of liquid. This is not always practicable; but it has been done, and as this figure may yet appear extraordinary, I hold the address of the manufacturer at the disposal of my opponent.

In conclusion, laying aside the appraisings of my opponent, I would remark that my figures, described at first as fantastic, are no more now than surprising, showing that they can hold their own by the fact of their being very real, which makes me think that one day I may convince even my opponent himself.

G. BLANCHART.

Brussels, 12*th September*.

[M. Blanchart did not apparently notice that we ourselves accepted the responsibility of criticising his experiments, about which we shall probably have more to say in a future number.—EDS. ELEC. REV.]

NATALIAN.—The effects produced by induction coils are similar to those of frictional electrical machines. The ordinary current of a few cells is turned into one of a very high tension, but little quantity, by using such coils, and no useful effect, such as is required for electric lighting, can be obtained by their use. At present the only cheap, convenient, and practical way of obtaining sufficiently powerful currents for electric lighting, either by the arc or incandescence method, is by the employment of dynamo-electric machines. You might obtain, say, 5 Swan incandescent lamps of about 10 candle-power by the use of 30 large "Grove" cells, but the expense of keeping up the battery precludes it from being of any practical value. We cannot see any way out of your difficulty, unless you have plenty of water-power at command for driving dynamo-electric machines, by which a number of houses could be illuminated from a central source. Individual outlay in purchasing a system of electric lighting is as much out of the question here as in South Africa, that is to say, for private house purposes. "Natalian" has no doubt read our description of the lighting of the Comptoir d'Escompte in our issue of August 12th, which was done entirely by means of batteries, but we should imagine that the cost of such an installation would speedily lead to its rejection. We shall be glad to hear again from our correspondent on any matters in which we can be of any assistance to him.—[EDS. ELEC. REV.]

AN OLD SUBSCRIBER.—We have the promise of a reply to our correspondent's questions concerning manganese, which we hope shortly to lay before him.—[EDS. ELEC. REV.]

ELECTRIC LIGHTING.—The Gare de l'Ouest, at Paris, has been illuminated with the Edison incandescent light. The same system has also been introduced into Besançon, the motive-power being furnished by a water-fall about a mile distant.

NOTES.

SUCCESSFUL COMPLETION OF THE WEST COAST CABLE. —We read the following in the *Panama Star and Herald* of the 19th ult.:—On Friday, August 4th, the steamships *Silvertown* and *Retriever* started from Pedro Gonzales Island, in the Bay of Panama, the former ship paying out cable to complete the section between that Island and San Juan del Sur, Nicaragua. Mr. Parsoné, general agent of the West Coast of America Telegraph Company, having volunteered to take charge of the temporary hut on Pedro Gonzales Island for the electrical tests, &c., necessary during cable laying, his services were accepted by Mr. R. K. Gray, and, with Messrs. Bailey, Norton, and Phillips, he remained at that island roughing it until Sunday last, when, learning by cable that the work at sea had been completed, they returned in the Pacific Steam Navigation Company's tender *Taboguilla*, which went to the island to bring them to Panama.

The steamship *Silvertown* returned, as already announced, on the 17th inst., with Mr. R. K. Gray on board, after having successfully completed the section to San Juan del Sur. The final splice of this section was slipped on the 10th, thus completing the whole telegraphic system of the Central and South American Telegraph Company.

Few persons are aware of the extent of this system, which runs from Lima to Payta, Peru; from Payta to Santa Helena, Ecuador; from Santa Helena to Buenaventura, Columbia; from Buenaventura to the Island of Pedro Gonzales, and thence to Panama; from Pedro Gonzales to San Juan del Sur, Nicaragua; from San Juan del Sur to La Libertad, in Salvador; and from La Libertad to Salinas Cruz, in Mexico. From Salinas Cruz a land wire crosses the Isthmus of Tehuantepec, and a cable thence from Goatzacoalcos to Vera Cruz, Mexico, places the line in connection with the United States and the Old World. The total length of electrical cable connections completed by the company amounts to 3,170 knots, a figure which proves the enormous amount of work which has been rapidly and successfully performed.

A flaw discovered in laying the Pedro Gonzales and San Juan del Sur section was easily removed within twenty-four hours of being discovered, and perfect communication through the whole line was re-established within twenty hours. The electrical tests were so accurately made that they located the flaw within one knot of its actual position. The main cable was at once grappled for and picked up in 700 fathoms of water. Reeling in was commenced, and very shortly afterwards the defective piece was made good. The cable which was picked up was found within 500 yards of its location on the cable companies' charts, a circumstance which proves the wonderful accuracy which must be observed by all concerned in such an extremely scientific and costly work as that which has now been so successfully and happily terminated.

The undertaking has been a great one. Now that it has been happily concluded, the few drawbacks which have been encountered having been overcome by foresight and knowledge, and the work having been performed on a coast hitherto almost, if not entirely, unknown to the promoters of cable enterprises, Mr. Robert Kaye Gray, and every one connected with his staff and the vessels, must feel satisfied with the satisfactory results which have attended their labours.

ELECTRIC LIGHTING DURING THE PRESTON GUILD FESTIVAL.—The streets of Preston, the People's Hall, and the large Dingle in the Pleasure Gardens were splendidly illuminated, by means of 25 Brush arc lights, upon the occasion of the visit of the Duke of Cambridge to the Guild Festival, which commenced on the 4th September, ending on the 9th. The effect of the light upon the ravine at the Pleasure Gardens was very fine when viewed from the top, it being a large natural ravine and very thickly wooded. The whole of the work was most satisfactorily carried out under the superintendence of Mr. G. Sharples, local agent for Messrs. Hammond and Co., who hold the concession of the Brush system for Lancashire.

THE SELLON-VOLCKMAR ACCUMULATOR.—We understand that the Electric Power Storage Company's business is just

now exceedingly active, the manufacture of the above-named secondary battery being carried out on an extensive scale in the company's works at Millwall. After this month we are informed that the output will be at the rate of 100 tons per week if needed, there being already about 250 men engaged in the work. This is a very satisfactory result of the company's operations, and will doubtless keep it to the fore in this particular branch of the electric light industry.

INCANDESCENT ELECTRIC LAMPS.—There is a long description in the *Newcastle Daily Chronicle* of the multiple filament lamp of Mr. Jameson. This invention is more mechanical than electrical, and its chief feature consists in its supply of carbon filaments, so that when one gives way another takes its place automatically. There is also an automatic arrangement inside the globe for cleaning it should it become clouded. This apparatus has already been referred to in our list of published specifications, as our readers are doubtless aware. The invention is being worked by the Albion Electric Light Company, and the lamp is said to be in successful operation in the works of the Tyne Electroplating Company.

THE ELECTRIC LIGHT IN PARIS.—The St. Lazare Station in Paris was lighted by electricity on the Edison system for the first time on Sunday evening last.

THE FAURE STORAGE BATTERY.—We read in the New York *Review of the Telegraph and Telephone* that the Light and Force Company, of No. 234, Broadway, controlling the Faure patents upon the lead storage battery or accumulator, announce that upon the appearance of the first Brush storage battery in the market suits will be begun to prevent their introduction. The Light and Force Company claim a monopoly of all the storage batteries in which lead plates and minium are the essential parts, and will contest any device having these features. The company is making preparations to light up a railroad train on the Pennsylvania Railroad with their batteries, and a branch organisation in Boston is preparing to light houses with Edison lamps fed by storage batteries. Mr. Edison is making a special lamp for use in connection with such batteries.

PATENTS FOR ELECTRIC LAMPS.—According to an American contemporary we see that with regard to the rumours of important patent suits between the different companies making incandescent electric lamps, the Edison Company in America claims a monopoly of the business upon the following grounds:—That it has patents covering (1) a a continuous conductor, the light-giving filament forming part of the circuit; (2) a filament of carbon; (3) high resistance—something never before obtained; (4) metallic "leading in" wires, ending in a clamp-like connection with the carbon; and (5) a process of manufacturing indispensable to the production of all and any of the incandescent lamps now in the market. When the Swan light, which the Brush Company is preparing to put upon the American market, is offered for sale, the Edison Company will begin a suit for infringement, and also against the United States Electric Light Company, should the Maxim lamp interfere with the business of the Edison Company.

During the last month the Edison light has been introduced in Everett's two hotels, one at No. 84, Chatham Street, and another at No. 98, Barclay Street, where it can be examined by the public. 250 lights are used in each place.

NORTH-EAST COAST EXHIBITION.—At Tynemouth we note the following exhibits by the "Pilsen"-Joel and General Electric Light Company:—Four Joel semi-incandescent lamps, six Joel semi-incandescent bracket wall lamps, fifty Gatehouse incandescent lamps fixed in chandeliers and brackets, and six Pilsen arc lamps worked by a Schuckert dynamo machine.

By the Hammond Electric Light and Power Company, Limited: A "Brush" machine and forty arc lamps, each of about 2,000 candle-power. Twenty of these lamps illuminate a considerable part of Tynemouth, the remainder being used in the White Garden dining-room and elsewhere.

The Maxim-Weston Electric Light Company, Limited, show ninety Maxim lamps, one regulator, one distributor, and ten Weston arc lamps, which irradiate the skating-rink.

The Albo-Carbon Light Company effectively light up the entrance-hall and adjacent rooms.

Messrs. Mawson and Swan, Newcastle, display bichromate, Bunsen, Daniell, Groves, and Leclanché batteries, insulators, carbons for electric lamps, &c., &c.

The Messrs. Siemens have sent their cable-ship *Faraday*, and Sir William Thomson his marine galvanometer.

There are daily exhibitions of the application of the telephone to the diving-bell, reported in a recent issue.

The electric light installations are highly satisfactory.

ELECTRIC LIGHTING.—The Glasgow Town Council at their meeting on Thursday week discussed a number of letters addressed to them on the subject of electric lighting, and afterwards remitted them to the Gas Committee to be very carefully considered.

As an endeavour to stop the numerous complaints of the bad lighting of the streets of Brighton, the civic rulers have decided to fit 593 lamps with new burners, at an additional annual expenditure of £434. In the anticipation, it is said, that they may help to show that gas can still compete favourably with electricity!

THE Provincial "Brush" Electric Light Company, Limited, have entered into contracts with the Corporations of Sudbury and Beccles for lighting some of the principal thoroughfares in their respective towns.

THE offer of the Edison Electric Light Company to illuminate a district of Portsmouth for six months at the cost of gas—light for light—has been accepted. A daily contemporary commenting on this agreement, says:—

> The result of this contract will be waited for with considerable interest. Hitherto the increased price of the electric light has been an insuperable obstacle to its popularity, but if it can be shown to compete in the matter of cost with gas a severe blow will be given to the latter system of lighting. Of course, it was foreseen all along that the older would ultimately give way before the younger rival, but not the most sanguine admirer of the electric light could have supposed that it would so quickly give such serious cause of alarm to the gas companies. The public, however, are not likely to spend much sympathy on a long-established monopoly. What they desire is a system of increased lighting at the present cost, or at least little higher, and if the Edison Company can satisfy the Portsmouth people on these points the gas companies will not be long in finding where the shoe pinches. No one for a moment supposes that the electric light will completely supersede gas, but one thing it is likely to do if brought into keen competition—it will urge the companies to greater alacrity in regard to the quality and price of gas. In both respects there is much need for reform, and the public will therefore be quite pleased to see the electric light perfected to an extent which will create a feeling of alarm among the gas companies.

A COMMITTEE to consider the Electric Lighting Act and to report with reference to the applications for authorisation to supply the town with electricity, has been appointed by the Town Council of Halifax.

THE Portobello Town Council, owing to a point of procedure, have been unable to deal with a letter from the Hammond Electric Light and Power Supply Company, asking the consent of the local authority to an application to the Board of Trade for a licence to enable the company to supply electricity in the district.

THE Montrose Police Commissioners have resolved not to commit themselves to any electric light company, and to allow the Hammond Electric Light Company to apply to the Board of Trade for powers to supply electricity in Montrose; but refused to concur in the application.

ON the recommendation of the Cleaning and Lighting Committee, the Edinburgh Town Council have declined to entertain the proposals of the Brush Electric Light and Power Generator Company to make trial of their light in the city. The clerk intimated that a letter had been received from the solicitors of the Hammond Electric Light and Power Supply Company, and also one from the company, asking the consent of the Local Authority to an application to the Board of Trade for a licence to enable the company to supply electricity in Edinburgh. A similar request from the local company was also submitted. The Lord Provost said there had been six or eight companies recently established, and they all seemed to be fighting with each other. These two had come in advance of the rest asking for powers; he thought it would be premature to grant any powers, and moved that the application be refused, which was agreed to.

THE question of street lighting came up before the Glasgow Town Council on Monday. The Lord Provost said parties interested in the electric light had made certain suggestions as to experimenting with the electric light in George Square, but the matter would come up again on report from the Watching and Lighting Committee.

THE Dumfermline Town Council are the recipients of a letter from the Hammond Company, but, with Scotch caution, they hold it over until they have perused the Act!

THE Town Council of Musselburgh have deferred replying to a letter from the Hammond Electric Light Company. A special meeting must be called to give the consent asked.

POPULAR DESCRIPTIONS OF ELECTRIC LAMPS.—It would be well if directors of electric light companies who are gifted with extraordinary facilities of speech would take the trouble to understand those matters which they attempt to explain at a company's meeting. The description of the "Gatehouse" incandescent lamp as given by Mr. Fellows to the shareholders of the "Pilsen"-Joel and General Electric Light Company is an amusing example of mistaken confidence in one's own ability. It is not necessary to reproduce it here, as our readers can peruse it for themselves in our City Notes. The object of a spiral of platinum or similar wire of definite length and resistance, between the leads of the lamp and the carbon filament, is to automatically increase the resistance of the lamp on any increase of current, by the heating of the spiral (the resistance of the carbon remaining almost constant when at an illuminating power of 20 candles and upwards), but the resistance of the platinum increasing for any increase of heat.

COLLEGE OF SCIENCE AND ARTS, GLASGOW.—It will be seen from our advertising columns that the College of Science and Arts, Glasgow, is about to commence the winter session. We have perused the syllabus of classes and observed the very complete course, at moderate fees, proposed for those desirous of entering one or other of the engineering professions or building trades. Lectures, with laboratory work in practical chemistry and electrical engineering, form a special feature. The students who went forward to the Science and Art and City and Guilds of London examinations seem to have done very well, and we understand that several have since obtained good appointments. We cannot do better than recommend those who are on the outlook for a suitable science training for their sons to obtain the very complete syllabus of this institution.

THE UNITED TELEPHONE COMPANY AND ITS ADVERTISEMENTS.—The above company has recently advertised a reward for the discovery of certain instruments said to be infringements of its patents. Mention is therein made of "Ander's" receivers. We are not aware that Mr. Anders, the well-known American inventor, has devised any receiver whatever, nor are we cognisant of any other telephone expert who bears the same name. Can it be possible that the United Telephone Company means "Ader," if so, we think it time that its effusive advertisements were more carefully worded, or that it avoided the appearance of endeavouring indirectly to damage its opponents. The addition of the letter "n" in the name is apparently an unpardonable mistake or an undignified abuse by them of, the advantages of press publicity and, the similarity of names.

TELEPHONIC COMMUNICATION WITH ABERDEEN HARBOUR.—The Board of Trade have now informed the Docks and Pilotage Commission of Aberdeen Harbour Board that they are willing to contribute the sum of £20 a year towards the expense of maintaining telephonic communication between the Telephone Exchange at Aberdeen, and the Coastguard stations at Cove and Donmouth, for a term of three years. This allowance to be considered as subject to re-consideration at the end of that time.

A DEPARTURE IN HONOURS AWARDS.—A contemporary says, "It is rumoured that Mr. John Pender is to be rewarded with a baronetcy for laying the cable from Alexandria to Port Said!"

We believe Mr. Pender arrived in America about the beginning of the present month. According to our American contemporary, the *Operator*, he is accompanied by Mr. W. Payton, his private secretary, and Mr. J. W. Fuller, the secretary and traffic manager of the Direct Cable Company. The party, on invitation of Mr. A. S. Hewitt, will go West as far as Yellowstone, on the private car of President Jewett, of the Erie Railroad. They also, by the courtesy of Mr. Jay-Gould, go over the Wabash, Missouri Pacific, and Union Pacific roads. On Mr. Pender's return to New York he will probably devote the remainder of his stay to business. He returns to England about the middle of October.

THE INTERNATIONAL CONGRESS OF ELECTRICIANS.—The French Chambers have voted a credit of £3,600 for the International Congress of Electricians which assembles in Paris on the 15th October next. The questions to be considered are: electrical units, atmospheric electricity, lightning conductors, the preservative or injurious influence of telegraph and telephone wires, earth currents, meteorological telegraphy and a standard of light. The question of submarine cables will be discussed by another assembly at the same time.

ON FEEBLE MAGNETIC AND DIAMAGNETIC BODIES.—By P. Silow.—In his essay "On the Maximum of the Magnetisation of Diamagnetic and Feebly Magnetic Bodies," Mr. Eaton contests the opinion put forward by several physicists, that the co-efficient of magnetisation, k, undergoes changes according to the magnitude of the separative power, x, in those bodies as well as in iron. In particular the results are doubted which the author has obtained for a solution of perchloride of iron (specific gravity 1·52), where the various methods employed proved with approximate unanimity the existence of a maximum of k in the vicinity of x.

In order to determine the constancy of k Mr. Eaton considered it needful to carry out new experiments, which unfortunately were not absolute measurements. He experimented with considerable separative forces derived from 1 to 7 Bunsen elements. From the fact that k remained nearly constant Mr. Eaton concluded that the magnetisation number must be considered as constant even for weak separative forces.

The author cannot admit that his conclusions referring to small forces can be refuted by experiments with great forces. Mr. Eaton regards as the weightiest sources of error in the author's measurements, and in those of Borgmann, the currents induced in the solution itself. In the cases where the measurement of k took place by means of induction currents (with a distant galvanometer), this source of error does not exist, since the integral action of a secondary induction excited by a momentary inductive impulse is = o. Where a direct pondero-metoric action of the magnetised liquid upon the galvanometer has been observed, this source of error can be important only if the first deviation has been observed. The position of rest of the magnet is free from this action.

From what has been said the author considers that his views as to the variability of the magnetisation number of perchloride of iron and the existence of a maximum of the same as by no means refuted.

He adds a few remarks on diamagnetic bodies. The values of k for bismuth as determined by different observers (with great separative forces) do not agree so badly as it appears to Mr. Eaton. From Weber's indirect measurements Prof. Stoletow finds for $-k10^{6}$ the values 14·6 and 14·9, whilst Christie's measurements give the value 14·6. Prof. van Ettingshausen found, with three different rods of bismuth, the values 13·99, 14·54, and 13·48. Since bismuth in most cases contains traces of iron (according to Christie, 0·06 per cent.) the near coincidence of the figures is very remarkable. It seems to intimate that the iron here is feebly magnetisable, as otherwise the observed number, k, would be very different according to the accidental proportion of iron. It would be interesting to examine alloys of bismuth with small known quantities of iron. [illegible]

In H. van Ettingshausen's figures a sma[illegible] increase of k with increasing separative force can be [illegible] remained in most cases. According to Schuhmeister, in [illegible] other diamagnetic bodies variations appear quite distinc[illegible]tly, decreasing in liquids and increasing in gases.

The author purposes examining the behaviour [illegible] of bismuth with much smaller separative forces.—*Wiedemann's Annalen.*

REMARKS ON THE ELECTRIC PHENOMENA ON CHANGES IN THE POTENTIAL ENERGY OF MERCURY.—By M. G. Van der Mensbrugghe.—A glass rod immersed in mercury, according to Dessaignes, becomes electric when withdrawn. According to Spring (*Bulletin de Bruxelles*, 1876, p. 1024) friction is here without influence, as on covering the surface of the mercury with lycopodium, the latter, on the introduction of the rod, penetrates entirely into the mercury. According to Mensbrugghe the phenomenon is due to the unequal tension of the recent surface of the mercury produced by the immersion of the rod and the old surface. According to Spring the electric excitement is reduced to $\frac{1}{3}$ by heating the mercury from 15° to 25° C., and to $\frac{1}{6}$ by breathing upon its surface. According to a theory proposed by Mensbrugghe as far back as 1876, any liquid mass whose surface increases or decreases is the seat of thermo electromotive energy. He considers, therefore, that when a change of surface takes place in presence of a sparingly conductive body the thermo current determines the change of the latter.

This is confirmed by the circumstance that the vacuum—more or less complete—of a barometer becomes luminous on moving the mercury; so, likewise, according to Hawksbec, does mercury when bubbles of air are drawn through it under the air-pump; also if mercury is forced through porous wood by atmospheric pressure an electric pendulum, if approximated, is attracted by the mercury.—*Wiedemann's Beiblätter.*

ON THE USE OF ZINC-COKE ELEMENTS IN ELECTROLYSIS. By M. D. Tommasi.—The author in reply to M. Berthelot states, that with two zinc-coke elements, with dilute sulphuric acid, a solution of potassium sulphate can be decomposed, whilst the decomposition cannot be effected with two zinc-platinum elements with dilute sulphuric acid. This experiment has been repeated, employing solutions of potassium sulphate of different degrees of strength from one per cent. up to saturation; but no appreciable difference has been observed in the electrolysis of these solutions. The decomposition of potassium sulphate in the conditions in which the author has experimented cannot be attributed to the presence of any strange bodies contained in the coke, for, even admitting, in the most unfavourable case, that the coke contains metallic substances, this would diminish rather than increase the difference of potential at the ends of the circuit.

As for the substitution of pure coke for platinum in a zinc-platinum element with dilute sulphuric acid, M. E. Becquerel observed in 1856 (*Annales de Chimie et de Physique*, 3e Série, T. xlviii.), that the electromotive force of the element would diminish instead of increasing. We know, nevertheless, since, that in elements with two liquids, the substitution of coke for platinum may either leave the electromotive force of the element substantially unchanged (as in a Groves or Bunsen element) or may increase it in a very strong proportion, as in a bichromate element.

It does not appear more probable that the increase of the electromotive force of coke elements can be due to the absorption of hydrogen or oxygen by the carbon; for, as the author has already shown, in order to obtain good results with these elements it is necessary that the carbon contains in its pores a gas—carbonic acid, for instance—which may by its presence hinder, or, at least, retard, the polarisation of the negative electrode of the battery.

The author will not deny that the absorption of certain gases by the coke may increase the energy of coke-elements, but this supposition can only be admitted when it has been experimentally proved.—*Comptes Rendus.*

OFFICIAL RETURNS OF ELECTRIC LIGHT COMPANIES.

THE Companies Act provides that within fourteen days of the statutory general meeting every company shall file a return setting forth the number of shares allotted and the amount paid thereupon. The following returns have been recently filed.

HASTINGS AND ST. LEONARDS-ON-SEA ELECTRIC LIGHT COMPANY (LIMITED).—The return of this company was made on 18th July. The nominal capital is £50,000 in 5,000 shares of £10 each. The number of shares taken up is 717. Upon 617 shares the sum of £2 10s. per share has been called up, and upon 100 shares issued to the Hammond Electric Light Company the full amount of £10 has been considered as paid up. The total amount of calls paid is £1,403, and together with the amount of £1,000 on the vendor's shares, the paid up capital is £2,403. The amount of unpaid calls is £139 10s.

ELECTRICAL POWER STORAGE COMPANY (LIMITED).—Return filed 11th July. Nominal capital, £800,000 in £10 shares. Number of shares taken up, 40,000. Upon 10,000 shares £5 has been called and paid, and the remaining 30,000 are considered as paid up in full.

GREAT WESTERN ELECTRIC LIGHT AND POWER COMPANY (LIMITED). — Return filed 5th July. Nominal capital, £250,000 in £5 shares. Number of shares taken up, 25,000. Upon 22,000 shares £2 10s. has been called up, the remaining 3,000 being considered as fully paid. The amount of calls paid amounts to £53,579, leaving £1,421 unpaid.

ELECTRIC FIRE ALARM AND SIGNALS COMPANY.—The return of this company was filed on the 1st inst., but of the nominal capital, of £100,000 in £1 shares, the seven shares taken by the subscribers constitute all at present issued.

RAILWAY AND ELECTRIC APPLIANCES COMPANY (LIMITED).—Return filed 22nd ult. Nominal capital, £500,000 in £1 shares. Upon 91,668 shares 12s. 6d. has been called up, and 12,000 shares have been issued as fully paid. The total amount of calls paid is £33,144 4s., which includes £1,499 paid in advance of calls due on August 25th. The total amount of calls unpaid is £24,148 6s.

UNION ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—Return filed 7th July. Nominal capital, £30,000 in £100 shares. 150 shares have been allotted and the full amount paid thereupon.

NEW PATENTS—1882.

4254. "Voltaic batteries." F. W. DURHAM. Dated September 7.

4260. "Electric governors for steam-engines or other prime-movers, electric governors for steam-boilers, and improved connecting appliances for steam-engine governors." A. BLECHYNDEN. Dated September 7.

4266. "Storing electrical energy." T. SLATER. Dated September 7.

4270. "Apparatus for generating electricity and applicable for lighting and heating purposes." W. R. LAKE. (Communicated by E. Brard.) Dated September 7.

4273. "Casting metals, or alloys of metals, for the manufacture of electrodes for batteries, for electrical purposes, and for other uses." H. WOODWARD. Dated September 8.

4286. "Electric bell and signal apparatus." T. R. BRAILSFORD. Dated September 8.

4289. "Needle instruments for speaking telegraphs." E. J. HOUGHTON. Dated September 8.

4299. "Accumulators or secondary batteries." W. A. BARLOW. (Communicated by L. Encausse and Canésie.) Dated September 9.

4303. "Electrical storage batteries." E. FRANKLAND. Dated September 9.

4304. "Electric lamps." J. G. SLATTER. Dated September 9.

4305. "Telephone receivers and transmitters." C. A. TESKE. Dated September 9.

4316. "Secondary or storage batteries for the accumulation of electricity." F. J. CHEESBOROUGH. (Communicated by A. K. Eaton.) Dated September 11.

4344. "Electric lamp carbons and manufacture thereof." R. HAMMOND and L. GOLDENBERG. Dated September 12.

4349. "Process and apparatus for the production of chloride gas and of metallic sodium by the decomposition of chloride of sodium through the agency of dynamic electricity." A. L. NOLF. Dated September 12.

4350. "Visually indicating electrical signals." B. J. B. MILLS. (Communicated by J. U. Mackenzie.) Dated September 12.

4352. "Manufacture of electrodes." N. LINNOCK. Dated September 13.

4355. "Galvanic batteries." O. C. D. ROSS. Dated September 13.

4362. "Distributing electricity for the production of light and power." L. GAULARD and J. D. GIBBS. Dated September 13.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

377. "Electric lamps." Sir C. T. BRIGHT. Dated January 25. 6d. The inventor employs two electro-magnets for separating and regulating the carbons of an electric lamp. The magnetic action of one end of the first of the electro-magnets separates the carbons to the required lighting distance upon the passage of an electric current. The other end of this first electro-magnet actuates an armature by the movement of which the second electro-magnet is put upon short circuit or neutralised. The feed is regulated by the second electro-magnet by means of clips or jaws taking hold of or releasing the upper carbon holder.

436. "Electric telegraph printing apparatus." J. IMRAY. (A communication from abroad by J. M. E. Baudot, of Paris.) Dated January 28. 1s. Relates to the apparatus described in the Nos. of the Review for the present year.

441. "Electric railways." C. F. VARLEY. Dated January 28. 4d. Consists of a metal conductor laid in a groove cut in a sleeper or non-conducting material, which sleeper is preferably creosoted or is impregnated with paraffin or petroleum, or other non-conducting fluid. This sleeper is preferably covered with guard-plates fastened on the sleeper. The guard-plates do not entirely close in the upper surface of the sleeper, but are so arranged as to leave a space sufficient to allow a roller or rollers, or contact-makers connected with the car, to make contact with the conductor, so as to convey the electricity from the conductor to the electric motor in the car. In order to reduce the loss of electricity that might be caused by leakage, the guard-plates are sometimes laid in sections of convenient length, separated from each other by a small space. The guard-plates may be hinged to facilitate the cleaning and inspection of the groove and the conductor.

489. "Electrical batteries." G. SKRIVANOFF. Dated January 31. 6d. The new electrical battery which forms the object of this invention belongs to the category of what are called dry batteries. It has the advantage, over those in use, of furnishing a constant and energetic current, and having at the same time a very small volume, which qualifies it for all the applications of ordinary batteries and also for use where existing batteries could not be introduced. This battery consists of three elementary parts: viz., a plate of retort charcoal, agglomerated charcoal, or any other conducting substance which cannot be attacked by acids; a plate of zinc carefully amalgamated; and an exciting paste applied to the charcoal. It is the use and composition of this paste which chiefly constitute the novel and distinctive character of the invention. The composition of the paste is as follows:—Chloro-mercurate of ammonium $Hg\,Cl^3\,NH^4\,Cl$, 10 parts by weight; Chloride of sodium $Na\,Cl$, 3.

497. "Electro-magnets and armatures, &c." G. LITTLE. Dated February 1. 6d. Relates chiefly to an improved method of constructing electro-magnets and electro-magnet armatures, for rapid action, whereby great power combined with great speed and economy are obtained, by reason of swift alternating direct surface contacts being effected between the armatures and the improved pole faces of the electro-magnets.

513. "Electric meters." C. V. BOYS. Dated February 2. 6d Relates to an arrangement of electric meter in which a balance is kept oscillating by clockwork, and as the spring of this balance there is employed a long strip of elastic metal, by which the balance is suspended, the torsion of this strip acting as the balance spring. This spring passes through a long slit in the arm of a lever, which has another arm at right angles to the former, connected to the armature of an electro-magnet, or to the core of a solenoid, having its coil in the circuit. The armature, or core, is drawn in one direction by the attraction of the magnet, or solenoid coil, and drawn in the opposite direction by an adjustable spring, in such a manner that the slotted arm of the lever takes a position embracing the torsion spring, determined by the current passing through the coil, leaving only that part of the spring between it and the balance free to twist and untwist, the free part being shorter the greater the current passing through the coil. The velocity of oscillation of the balance is thus so proportioned to the current that an index moved by the clockwork which is governed by the balance registers the amount of current passing through the coil in a given time.

538. "Electrical accumulators." W. R. LAKE. (A communication from abroad by J. J. Barrier and F. T. de la Vernède, both of Paris.) Dated February 3. 6d. In carrying the said invention into practice, the inventors provide a ribbon or band of lead, which may be either smooth, channelled, perforated, or otherwise treated for giving to it as large a surface as possible. This band may be from half a centimetre to four centimetres in width, and from one-tenth (1-10th) to one-half (½) a millimetre in thickness, but these dimensions may be varied according to circumstances. The said ribbon or band is manufactured from lead wire of the desired thickness, which is passed through rollers; it is made endless, and coiled upon a reel or winder, which gives to the element the desired shape, such as circular, square, rectangular, triangular, or any other geometrical form or figure which experience may show to be desirable. Whilst being coiled, the bands pass through a semi-liquid paste or composition, which becomes after several hours a strong and firm cement. This cement, or mastic, is composed of platinised carbon, litharge reduced to a fine powder, and of glycerine.

541. "Electric or magnetic motor." T. MORGAN. (A communication from abroad by J. C. Cuff, of Singapore, and W. Judd, of Penang.) Dated February 3. 6d. This invention is for the purpose of supplying a simple motor for those purposes which require a reciprocating movement, without employing any crank or rotary motion to produce it.

542. "Regulating the transmission of electrical energy." W. R. LAKE. (A communication from abroad by Maurice Levy of Paris.) Dated February 3. 4d. Relates to improved electrical apparatus for regulating the transmission of electrical energy, but which is also capable of being used as a speed regulator for machinery of various kinds. (*Provisional only.*)

546. "Electric fog-signalling." E. MOXON. Dated February 4. 2d. Has for its object the better prevention of collisions on the railway in foggy weather by a new and improved method, whereby increased facilities are afforded persons in charge of trains for knowing the exact position of the arms of the semaphore or signals without being able to see them. (*Provisional only.*)

559. "Printing telegraph apparatus." W. R. LAKE. (A communication from abroad by La Société Secondo Roos and Francesco Ostrogovich, of Florence, Italy.) Dated February 4. 8d. Relates to the printing telegraph described in the number of the Review for April 1st, 1882.

563. "Arc electric lamps." A. J. JARMAN. Dated February 6. 6d. Relates to improvements in arc electric lamps. A solenoid or electro-magnet is mounted in such a manner as to be adjustable with regard to its core or armature, so that the desired amount of attraction may be obtained in either the core or armature for the current flowing round the coil or coils. The core or armature is provided with lugs, carrying pins or rollers, upon which slide cross-bars, pinned at their centres or crossing points, the opposite ends of these cross bars resting, when no current passes through the lamp, upon a bed-plate, which keeps them extended, like the letter X, and causes the reverse end to that resting upon the bed-plate to press upon the pins or rollers fixed in the lugs of the core or armature above referred to. Near the bed-plate end the crossbars are pivoted to two clutch blocks, or gripping pieces, accurately fitted, so as to embrace the rod carrying the upper or positive carbon, which when no current passes, rests upon the lower or negative one, and completes the circuit. Upon a current flowing through the coil or coils of the solenoid or electro-magnet, the core or armature is drawn into or towards it, first causing the cross arms to straighten and force the clutch or gripping pieces against the rod carrying the upper carbon, and then lifting it and establishing the arc. By means of the crossbars a perfectly parallel motion is imparted to the clutch pieces, so that they grip the rod firmly, compelling it to obey the use of the core or armature. The slightest decrease in the magnetisation of the core or armature causes the cross arms to extend, releasing the rod and shortening the arc.

578. "Electric lamps." B. J. B. MILLS. (A communication from abroad by W. M. Thomas of Cincinnati, America.) Dated February 7. 6d. Fig. 1 is a perspective view of an electric lamp embodying the invention. Fig. 2 is a partly sectional elevation

FIG. I.

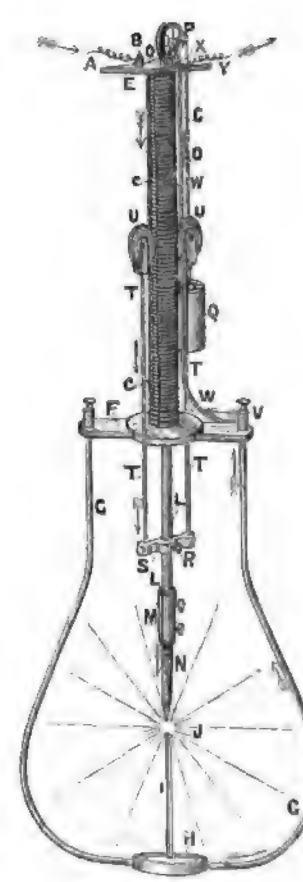
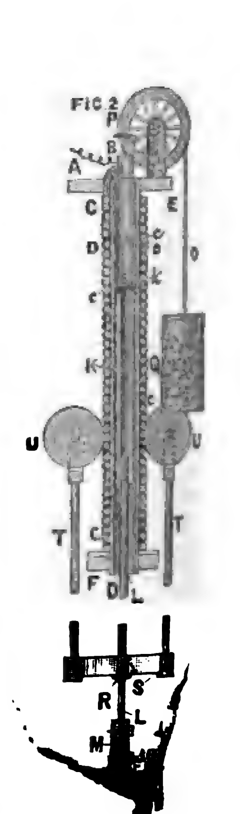


FIG. 2.



of the coil and adjuncts. Along the narrow track [illegible] wheels, U, of which tracks one is seen at *c*, fig. 1, [illegible] other insulating envelope of the wire is removed [illegible] the metallic surface of the wire at that part and [illegible] in direct electrical communication with the wire [illegible] being) point of contact. The operation of the [illegible] obvious. The shunt wheels, U, having with the [illegible]

S, T, been by means of set screw, B, fixed at their proper height relatively to the core, X, and the counterpoise, Q, having been suitably loaded so as to diminish the virtual weight of the core and its appendages to that which just serves to cause their descent at any relaxation of coil magnetism, a connection of the wires, A and Y, with the generator causes the positive current to flow as indicated by the arrows, and the positive electrode to detach itself from the negative, so as to create an arc-interval. Any wear or dislodgment of the carbon tip has the well-known effect of increasing the tension and decreasing the electric flow, with corresponding reduction of coil magnetism. This permits the weight of the positive element to prevail over the coil suction until the two opposing forces, gravity and magnetism, being restored to equilibrium, the normal arc-distance is resumed.

607. "Telephone transmitters." R. and M. THEILER. Dated February 8. 2d. Relates to the construction of apparatus for the electric transmission of articulate speech, and has for its object the obviation of certain faults and disadvantages which exist in the various forms of telephone transmitters hitherto in use. In most of the apparatus hitherto constructed for the same purpose, the sound vibrations were first caught up by a tympanum or sounding board, usually termed diaphragm, and this then either communicated the received vibrations to a series of contacts called "microphone," or it exerted a varying pressure upon a fixed, but elastic, conductor. All such diaphragms, whatever material they are made of, give out a sound or musical tone of their own when vibrating freely, and this sound interferes with the clear and accurate transmission and reproduction of articulate speech. Any variation of temperature also alters the tension of such diaphragms, and consequently disturbs the requisite adjustment when a fixed contact is used. Such diaphragms are, moreover, incapable of transmitting and reproducing certain parts of articulate speech, as, for example, the sound of the letter "s." All these faults and disadvantages are obviated by the invention. The inventors do not make use of any diaphragm whatever, but cause the vibrations to impinge upon any mass or substance which is capable of transmitting such vibrations in a longitudinal direction. In one form or construction of the apparatus the inventors use cane, pith, or straight grained pine wood, and fix either of these substances in such a manner that the vibrations impinge upon the end or cross cut thereof. The size and shape of the said substances is immaterial. The inventors then fix a series of contacts, usually called "microphone," on the opposite end or cross cut of the said substance and connect the microphone in the usual manner with a battery circuit. The form of microphone preferred consists of two fixed carbon or metal cylinders with a third cylinder suspended in such a manner that it slightly leans against the fixed cylinders and thereby completes the circuit. In another form or construction of our apparatus the inventors suspend a short bar or a block of any substance capable of transmitting sound vibrations and cause such bar or block to lean slightly against one or more fixed contacts or conductors, whereby the battery which may include an induction coil is completed. The sound vibrations impinge directly upon this suspended bar or block. Several bars or blocks may be used. When the suspended substance is a nonconductor of electricity the inventors attach a conductor to that part of it which leans against the fixed contact or contacts. By making the suspended bar or block of a shape possessing sharp edges, the transmission of the sound of the letter "s" is easily accomplished. In the form of apparatus last described the contacts or conductors need not consist of carbon. The inventors obtain the same results by making these contacts of tellurium and its alloys or of an alloy of antimony and tin. (*Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent.*)

621. "Effecting and maintaining the continuity of divided and sub-divided electric currents for lighting." JOHN BANTING ROGERS. Dated February 8. 6d. The object of this invention is an improved system or means of effecting and maintaining the continuity of divided and subdivided electric currents for lighting purposes without possible disruption between stations however numerous or distant apart. For the purposes of the invention a series of negative and positive conducting wires radii are carried from one central power generating station, and their terminals are put in connection with other stations which are also in connection with the several stations of that series and also by other or subsidiary conducting wires to more distant stations which are themselves in connection with each of the distant stations and with the intermediate stations and the main station or stations.

626. "Electric lamps." A. A. COMMON. Dated February 9. 6d. Relates to lamps of the arc kind where carbons are used vertically and the upper carbon holder only moved. This holder is formed of steel tube, and the necessary motion is obtained by means of a core and solenoid with or without a shunt; this core lifts a balanced lever with a variable axis or fulcrum. The lever lifts the rod by means of a suitable clutch, the finger of which may be made to engage with any part of the lever within its range, thus altering the lift or leverage. To prevent the sudden drop of the carbon holder when released by the clutch, a regulator is made, by filling the carbon holder with mercury and using a rod and piston, this piston having a valve of platinum to allow a quicker motion up. To prevent the spilling of the mercury when the lamp is laid down or turned up, the upper part of this tube is enlarged and provided in the top with a sleeve or long collar for the rod to work through, so as to form a trap to prevent any leakage of the mercury.

632. "Signalling by electricity on railways." S. C. C. CURRIE. Dated February 9. 1s. 2d. Relates to an automatic system of electric signalling.

661. "Telephone exchange systems and apparatus, &c." H. H. LAKE. (Partly a communication from abroad by T. B. Doolittle, Bridgeport, America.) Dated February 11. 8d. Relates to that system of telephonic intercommunication for private and business purposes which consists of a number of telephonic lines assembled together and so organised that each individual line establishes a direct means of communication between one or more subscribers and a central or connecting office. By means of such an organisation each subscriber, or other authorised person, provided with a telephone or other equivalent instrument may at any time, through the intervention of the central office with which he is immediately connected, be placed in direct communication with any other subscriber who is connected in like manner with such central office which is technically termed an exchange office.

689. "Telephone receivers." (A communication from abroad by G. M. HOPKINS of Brooklyn, in the County of Kings and State of New York, United States of America.) Dated February 11. 6d. The object of this invention is to secure in receiving telephones compactness, lightness, and increased efficiency. Fig. 1 is a diametrical section of the improved receiver, showing the arrangement of angled magnets, iron core, and helix. Fig. 2 is a plan view of the telephone receiver shown in fig. 1, the diaphragm being removed to show internal parts. The cylindrical case, A, is closed at one side, and is provided on the other side with an annular cap, B, which screws on the case and clamps the iron diaphragm, C, at the edge tightly between it and the top of the case. In the centre of the case, and in close proximity to the diaphragm, C, though not touching it, there is a soft iron magnet core, D, having a broad thin flange, E, formed on or attached to its inner end. This magnet core, D, is held in its place by a screw, F, passing loosely through the back of the receiver case, A, and into the end of the soft iron magnet core. Between the magnet core, D, and the back of the case, A, and surrounding the screw, F,

FIG 1

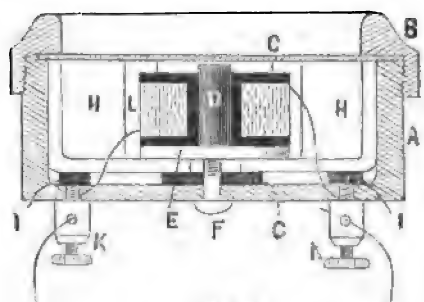
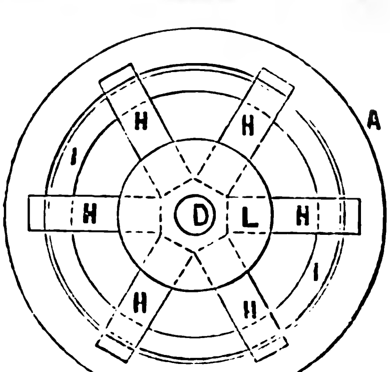


FIG 2



there is an elastic rubber ring, G, of smaller diameter than the flange E, of the core, D. Between the elastic rubber ring, G, and the flange, of the core, D, are placed the ends of several right angled permanent magnets, H, with their opposite ends in contact with the iron diaphragm, C, poles of like name being placed in contact with the diaphragm. Perfect contact of the ends of the magnets with the diaphragm is secured by the pressure of an elastic rubber ring, I, placed between the magnets, H, and the back of the case, A, as near as possible to the angle of the magnets. The soft iron magnet core, D, is surrounded by a fine wire helix, L, whose terminals are connected with the binding posts, K, screwed into the back of the case, A. With this arrangement of permanent magnets, soft iron magnet core, and iron diaphragm, the magnet core and iron diaphragm are magnetic by induction, and there is a consequent point in the centre of each. The two points being of opposite names, there is a constant attraction between the diaphragm and magnet core, which is varied by the passage of a primary or secondary current over the wire of the helix, L.

CITY NOTES.

OLD BROAD STREET.

PILSEN-JOEL AND GENERAL ELECTRIC LIGHT COMPANY (LIMITED).

THE first ordinary general meeting of the shareholders of this company was held at Cannon Street Hotel, on Monday last, Sir Rawson W. Rawson, K.C.M.G., C.B., occupied the chair.

The Secretary, Mr. E. T. Gregory, having read the notice convening the meeting,

The Chairman said: You are aware, Gentlemen, that the present meeting is convened in accordance with the provisions of the Com-

panies Act, which require that a general meeting of the shareholders should be held within four months of the registration of the company; that is the first purpose for which we are met. The second is to form ourselves into an extraordinary meeting after the business of the general meeting is finished, for the purpose of making certain changes in our Articles of Association, which the Committee of the Stock Exchange consider desirable in the interest of shareholders. There is therefore little doubt that you will be ready to agree to the proposals of the directors in the extraordinary meeting. Although, this is not a meeting at which it is usual to enter into any detailed statement of the proceedings of the company, which we hope to do about the end of the year, when we hope to be able to present you with a very satisfactory report; yet the directors have pleasure in meeting their shareholders and in giving them information as to the operations of the company since it was formed. The company was registered on May 15th. It was advertised next day, and you may be perhaps aware that such was the anxiety of the public to obtain shares in any new electric company at that time, and we hope, especially in this Pilsen company, that in the afternoon of the 16th, we were obliged to advertise that no more applications could be received in town after the 17th, and from the country after the 18th; and, in fact, when we examined our applications, we found that for the 28,000 shares which we had to dispose of to the public, we had applications for 208,000; that is, for the capital of £140,000 we had applications made to the amount of £1,040,000—that is, more than seven times the number of shares of which we had to dispose. The allotment was completed on the 23rd May, and the distribution was to about eight hundred shareholders. These shares were issued to the value of £5. At first we contemplated to call up £2, and then after a short period another pound, making three; but the directors have hoped to be able to conduct the business with a capital of £2 a share, which is all that has been called up, and that amount has all been paid, with the exception of the trifling sum of £75, by a shareholder who happens to be abroad in the United States at present. The next step was to obtain the legal transfer of the patents from the vendors. Some little delay occurred with regard to that, caused by the pre-existing engagements existing between the vendors and the patentees, which necessitated a certain delay in getting a settlement and quotation of our shares from the Committee of the Stock Exchange. They very properly do not allow companies to obtain that advantage until they are satisfied that all preliminary forms have been completed. The consequence was that it was only on the 5th July that our company was formally constituted by the transfer of the property from the vendors to the present Pilsen-Joel and General Electric Light Company. From that date we consider we have been constituted, and that we have been at liberty to dispose of the capital of the company in the manner we considered most judicious for the interests of the shareholders. That is only two months ago. Our existence is very brief, and the shareholders cannot expect that we have been able to do a great deal in that short period. Other circumstances also have influenced our operations. You are aware that the company came into existence, I may say, on the crest of the last wave of public excitement in favour of shares in electric lighting companies. Before even our shares were allotted they were in the market, and selling at a considerable premium, but before they were allotted, a reaction as rapid and as sudden as the excitement, had set in, and consequently before the company was actually formed and in operation it had to take a very different view of its prospects from what it had when it was first created. When it was first created it might have hoped to be able to sell a number of concessions, to form a number of sub-companies, in the same way as its great predecessor, and other predecessors, but from the moment of its existence, it was pretty clear that the company must look for its future profits specially from manufacturing, from establishing a successful and economical manufacture of its valuable patents, from which it would be able to obtain a permanent annual income that would amply reward its shareholders for their investments; and that has been the aim of the company from the time of its existence. Within a short time after its creation, certain concessions were proposed, but with one or two exceptions, it was quite clear that the parties had no intention of doing business in the matter. Their sole object was to gain the advantage of promotion money; and it did not seem in the interest of this company to be associated with companies not likely to be a commercial and financial success, and therefore it has not yet formed any sub-companies, but it hopes that when it has shown the excellence of its lights and advantages to be derived from association with the company we should be able to form the local associations which will add to the profits and increase the reward of the investors. Well, then, after having determined that manufacture was to be our great object, we lost no time in seeking for a suitable factory. We consider that we were fortunate amongst those who presented themselves, in obtaining at Kentish Town a set of buildings—for it really is three separate blocks connected together—of the most substantial construction, in an excellent situation, with good light, admirably adapted for our particular manufactures, and with which we shall be shortly connected by telephone. The advantage of this was that not wishing to burden ourselves with too large an affair until we were satisfied not only as we ourselves were of the excellence of our lamps and of the profits that may be derived from their manufacture, but that the public should share in that confidence, we were unwilling to burden ourselves with too large an establishment; we therefore engaged this factory for only three years certain, with the power of taking a lease afterwards of 7, 14, or 21 years. So that if, as we expect, the manufacture will be a success, and a large success, we have the means of continuing there and developing our manufacture. Another advantage of this was for the first six months we have actually paid no rent, so that until we are fairly at work we are rent free in that factory. The third advantage is that from its constitution we can begin modestly in one block if we will employ about two hundred hands, and can advance as our manufacture and as the demand for our lamps increases, and as we gain experience in our manufacture we can advance from this single block, employing 200 hands into the other blocks, each of which will employ a similar number, so that we may before the end of the year be employing from 400 to 600 hands in that manufacture. At present we may say we have not actually been employed there more than eight or ten weeks; we have at present upwards of 70 hands at work, and we are only waiting for larger employment until our installation is complete, until all our shafting and tools, which there appears to be a great difficulty in bringing together. As soon as that is completed we shall be enabled to enter fully into the occupation of that part, and to turn out a sufficient amount of lamps and dynamo-electric machines amply to repay from that block alone the due interest upon the capital that has been employed upon the concern. At first, I ought to say, we had the expectation that we should be able to get a supply of machines and Pilsen lamps from abroad sufficient to meet any immediate pressing demand, but it was found that such was the demand upon the factories at Pilsen and Neuremberg for these machines and lamps that they could only supply a small order for us, and therefore we have been thrown back entirely upon our manufacture. The question was whether we should employ other parties to manufacture for us. Now, that was well considered by the directors, and there were many reasons why we should at once embark in our manufacture, and it was for the advantage of the shareholders that we should confine ourselves to our own manufacture. First, the season admitted of a certain amount of delay, because in the middle of the summer people were not very anxious to obtain new lamps of this description, and we had every reason to hope—as we have every reason to hope now—that we shall have a supply when the demand is pressing upon us. With regard to our manufactory, we are now manufacturing each of the kinds of manufacture which we are able to offer to the public, for which we have the patents. We have the full installation of our incandescent light —the Gatehouse light—which, when we were created, has appeared in our prospectus, was not then perfected. It is now perfected and very much improved, and we are turning out a sufficient number daily of these lamps to supply our demands. We have a supply of Joel lamps, a supply of Pilsen lamps, on the point of completion. We have dynamo machines in hand, and we expect that in the month of September we shall have a sufficiency of everything that we offer to the public to supply our customers. We have also obtained since we were created patents for a new accumulator, which we believe will turn out a very successful invention. We believe it will be in efficiency, in economy, in convenience as regards price and as regards weight, and that it will recommend itself to the public in comparison with any other that exists. And if these expectations are realised, as we feel confident they will be realised, we shall have a perfect system of lighting in our four systems of Pilsen arc, Joel semi-incandescent, Gatehouse incandescent, and dynamo machine suitable to all of them, and this accumulator to supply the public in the most efficient manner. With regard to other operations, I may say that we have been limited by the small supply of machines and lamps which we have been able to avail ourselves of. We took over a certain stock from the vendors, who had obtained them from the patentees, and we obtained as many dynamos and lamps as the company's agents at Pilsen and Neuremberg could supply us with. These we have made available; utilised as far as possible. We have exhibited them in London at Messrs. Baker's, at Holborn, where, by-the-bye, I may state we have obtained a site for a station which promises a demand for lamps in the surrounding buildings sufficient to offer to the company a very profitable installation there, and at Messrs. Crisp's in the North of London. At Liverpool, where we have at present agents employed in visiting the different large buildings and obtaining orders for our lamps, and wherever our lamps have been shown they have obtained the highest favour. We believe in the Pilsen lamp we have the steadiest and brightest, the easiest to work, the safest, the most judicious light; and in the same way we are satisfied that in the Joel and Gatehouse lamps we have excellent lamps to offer to our customers that cannot be surpassed by any other, and we believe that we have everything that the public can desire in the shape of electric lighting. I may mention that we are in communication with two of the most important dependencies of the crown for concessions in them; and inasmuch as there we should be able to give the right of manufacture which we cannot give to *concessionnaires* in the United Kingdom, we believe we shall be able to sell the right of sale and manufacture at great advantage for our shareholders. It may be satisfactory to our shareholders to notice that the Pilsen arc light and the Joel semi-incandescent light obtained the gold medal of the jurors at the Crystal Palace, and in the same way that the arc light at Paris likewise obtained the gold medal. There is therefore no doubt that the Pilsen light stands possessed of the highest testimonials both from the English and from the French jurors. I have very little more to say. Although we have not thought it necessary—that it is advantageous—to expend funds in public exhibitions that do not yield an immediate profit, trusting more to the excellence of our lights when they are fairly exhibited by sale to the public, yet we have provided for the exhibition of our light in the Crystal Palace at the coming exhibition in the ensuing winter, and we have also sent our lights to the North East Exhibition at Tynemouth, where the parties supply us with the power, and the expense of exhibition will be, therefore, comparatively slight. In conclusion, I would say that the object of the directors has been to insure a substantially profitable manufacture of their several patents, to study strict economy in their arrangements, to avoid all expensive agencies, to refrain from costly and unremunerative exhibitions, and so to conduct the operations of the company as to realise, as they are confident they will realise, for its shareholders an ample and most satisfactory return for the money invested in the shares of this company (hear, hear). Before I sit down I shall be very happy, on the part of the directors, to answer any question that may be required. This is not an annual meeting, but of course if any shareholder wishes to put a question I will do my best to answer him, and I hope I shall

be able in all respects to give a satisfactory answer to any question that may be put.

Mr. Bladon asked with reference to the floating of the Scotch Company in connection with the Pilsen-Joel, which proved a failure, whether that involved any loss to their company, or if on the contrary they had taken the precaution to get a deposit. If that were so, there might be a small profit even if it had not been floated. From the chairman's statement it appeared that they need not fear as regarded the future. His application for shares had been made on the strength of what he had seen at the Crystal Palace. He believed that in the Joel light there were elements of success that would enable it to beat any other light of the kind either for steadiness or efficiency. His belief as to the Pilsen was that it was quite equal to its work. The only light he had not seen there was the Gatehouse incandescent. As there were great doubts about the validity of the patents for the incandescent lights it would be satisfactory if the chairman could show that there was something special in their patents which would put them beyond the pale of proceedings against them such as were pending against other companies which he need not name. His own impression was that their patents would hold their own with any others, and that as the public began to see the value of electric lighting confidence in their system would increase, and then they need not fear the *brush* in any sense of the word. (Laughter.)

The Chairman: I have much satisfaction in answering the first question. We were certainly not the losers of a farthing by the Scotch company's failure. It is unnecessary to refer to what took place at that time. The *bouleversement*, the upsetting of public opinion with regard to the electric light, was the cause of the failure of the Scotch concession, but the company lost nothing. It had nothing to do whatever with the preliminary arrangements of that company, and therefore it simply dropped down without injuring us in the slightest. With regard to the Gatehouse light, the shareholder did not see it, very likely, because it was only exhibited towards the end of the exhibition, and it really was not at that time perfected. In our advertisement we stated that the Gatehouse lamp was not then perfected. It is now perfected, and as far as we have seen, it is an admirable lamp, and is likely to be a very remunerative manufacture (hear, hear).

Mr. Bladon: You have not told us whether your lights interfere with any existing patents. We hope to hear that we may be free from adverse litigation. With regard to incandescence *in vacuo*, *e.g.*, Edison seems to claim it entirely.

The Chairman: I suppose we must take our chance with the rest as regards incandescence *in vacuo*, but as regards the means by which we gain our incandescence, we have no fear whatever of any other company claiming the patent, and I ought to say that the great advantage of the Gatehouse, as far as we know it, is its endurance, its vitality, that it is less likely to break, to die, than any other lamp that we are acquainted with.

Colonel Maturin said that they had listened to a very satisfactory statement indeed. There was no doubt at the present moment that there had been a very great subsidence of excitement with regard to electric lighting. He took it that all the shareholders in that company, like himself, were firm believers in its future, and it was satisfactory for them to know that they were prepared to act when the proper moment came.

The Chairman: If no other gentleman wishes to put a question I think we will now consider the business of the statutory meeting completed, and we will resolve ourselves into an extraordinary meeting for the purpose of making changes in the Articles of Association which have been suggested to us, and, in fact, to a certain extent required from us by the Committee of the Stock Exchange. They are all in favour of the shareholders. The directors have not the least objection to the changes, and they propose them to you with all heartiness. I will therefore, if the shareholders will consider that the general meeting is now ended, and that we have formed ourselves into an extraordinary meeting, read the notice again in order that you may understand what the object of the extraordinary general meeting is. The notice reads that we meet for the purpose of considering, and if deemed expedient of passing, the following special resolutions for amending certain regulations contained in the Articles of Association of the company. The first resolution is to alter the fourth article of association by erasing the words from "whether," in the fourth line to the end. The article to stand thus:—"The directors may from time to time allot, issue, or dispose of shares to such persons on such terms and conditions and in such a manner as the directors may think advantageous to the company." Now, the following words it is proposed to delete:—"Whether the amount payable or paid in respect of any shares be equal to or less than the nominal amount thereof." The Committee of the Stock Exchange thinks it should not be in the power of the directors, without the consent of the body of the shareholders, to sell their shares at a discount; we hope we may have no occasion to do anything of the kind, and we are quite willing to appeal to our shareholders, if it should be necessary. I therefore beg to propose that these words, "Whether the amount payable or paid in respect of any share be equal to or less than the nominal amount thereof," be omitted. The resolution stands to alter the fourth article by erasing these words.

Frank P. Fellows, Esq., F.S.A., said: I beg to second the resolution moved by the chairman. The chairman has so fully and succinctly stated the progress of the company that I think it almost unnecessary to add anything to what he has said. I may perhaps, however, say this, that having been for ten years at the Admiralty inspector of the accounts of the Dockyard, and having the charge of perhaps the largest establishment in the world, that is the 150 manufactories of the dockyard, so far as the accounts were concerned, I have consented to inspect the factories from time to time along with your chairman as a committee of two. We have been up regularly every week to inspect the factory and I, living near, have been there two or three times myself. Everything is on a satisfactory basis. Of course the only test is the result, but in this short time in which the company has been in existence, they are in a position to make any quantity of the Gatehouse incandescent lamps. The great advantage of the Gatehouse is this, that we believe it will last longer that any other lamps of which we know. That is, if you hit a Swan lamp it will break, but if you hit a Gatehouse it will not break, because of the twisted platinum wire which connects the carbons; that protects the carbons and that is, we believe, the great advantage of the Gatehouse incandescent lamp. At first we made them to a certain extent by rule of thumb, but now we make them of one uniform resistance, so as to be able to have all the lights in a room of one uniform tenor of light. I was lately at the British Association, and I noticed some lights there of which some were white and some of very brilliant light, but we shall be able to have all our lights of one uniform intensity. We have made, and successfully made, a number of Joel lamps, so that we can turn out any quantity. We are now making the Pilsen lamps, and shall soon be able to do this satisfactorily. As the matter has been entered into by Sir Rawson Rawson I will not enter further into it, except to say that our object in the factory has been to be as far as possible independent of outside aid. We may, if there is a great demand, feel it necessary to get outside aid, but we wish to be perfect in ourselves so as to supply everything that is asked by our customers. I can quite endorse all that has been said of the great benefit of the accumulator secured to us. It would not be wise to say more upon it at present, therefore I shall content myself with seconding the resolution.

The resolution was put to the meeting and carried unanimously.

The Chairman: The next resolution is to amend the 81st article by altering 1886, in the 7th line, to 1884. The object of this is to shorten the life of the existing directors so as to give you the opportunity of putting an end to their existence in 1884 instead of 1886. We hope to be able to conduct your business in such a way that it will be satisfactory to you to continue their existence up to the period named in the original articles of association. I propose, therefore, that the word "1886" be altered to "1884."

Major-General Henry Hopkinson seconded the resolution, which was then put and passed unanimously.

The Chairman: The next resolution is to erase the 85th article. I need not read it at length. The object of the article is as to how a resolution of the board can be made equivalent to one of a general meeting. The board has no desire to exercise this power, it would rather work with its shareholders than independent of their authority, and therefore it has no objection whatever to the omission of this article of association.

The resolution was seconded by Dillwyn Parrish, Esq., and unanimously passed.

The Chairman: The fourth proposal is to omit the 100th article. Its object is that any regulations that may be made by five directors should be deemed as valid as if passed at a meeting of the directors duly summoned. The object of erasing this is to make sure that all the directors shall have notice of any meeting at which the resolution of the board shall be passed. When there is a hurry to gain the authority of the board, the secretary might visit five of the directors and get their authority when perhaps the other two might be in any part of the kingdom not available. However the board has no objection to the abrogation of this proposed power, and therefore I propose to you to erase the 100th article.

John Goddard, Esq., seconded the resolution, which was then carried unanimously.

The Chairman: Our Solicitor informs me that it will be necessary to hold another General Meeting for the purpose of confirming the resolutions of to-day in regard to the alterations of the Articles of Association. We shall therefore be obliged, much against our will, to call you together again after fourteen days, but we hope there will be no difficulty in meeting for that purpose. I may now inform you that the business is completed, thank you for your attendance, and say that I myself individually, and I think I may speak on the part of my fellow directors, am much gratified by the view that appears to be taken by the members present of the policy which the board has adopted with regard to the operations of the company.

Mr. Bladon: I have very great pleasure in moving a vote of thanks to the Chairman and Directors. I am quite sure of one thing that you need not be discouraged by the fact that the electrical company excitement did not keep at the top of the wave; the shareholders ought to feel a special confidence in their incandescent light. If it will not only burn *in vacuo* but otherwise, it is a mere question of time, and a perfect certainty that the shareholders will be amply satisfied with the results.

Mr. A. Parrish seconded the motion, which was then put and carried by acclamation.

The Chairman briefly responded and the proceedings terminated.

AUSTRALASIAN ELECTRIC LIGHT, POWER, AND STORAGE.

The first meeting of this company was held at the offices on Tuesday, September 11th, Mr. Randolph C. Want in the chair. The report stated that as soon as the company was formed and the capital subscribed, endeavours were made to secure an influential representative in Australasia, with a view to starting the company's business there. They considered themselves fortunate in having been able to come to an agreement with Sir Julius Vogel, then about to proceed to Australia, and who was largely interested in the company and well known in the colonies. Sir Julius left England in May and arrived at Melbourne on the 26th of June. His advices, being received by telegraph, were necessarily brief, but they were of such a character as to encourage the directors to entertain favourable opinions of the

company's future, and to hope for a satisfactory conclusion to several pending negotiations of considerable importance for electric lighting.

The Chairman stated that the meeting had been convened that day to comply with the requirements of the statute. He thought it would have been better if they had been in the position of delaying the meeting till they had heard more fully from their representative in the colonies, but as the law laid down they had been obliged to be called together. He felt that the company was formed on a sound and solid foundation, and that its prospects were good. He had no doubt that many of the shareholders would have been more pleased if they had found that the company had been enabled to dispose of some of its concessions to other companies, but it was thought that the best plan would be for the company to have its own installations at first. They were at present only hearing from Sir Julius Vogel, their representative in the colonies, by wire, but the accounts were very satisfactory and gave promise of a large business in the future. Arrangements, it was understood, had been concluded for the lighting of the railway station at Melbourne, which would no doubt be a good advertisement for the company. A contract had also been completed for the lighting of the capital of Western Australia, which would, it was believed, lead to other towns following that example. According to the telegram from Sir Julius the number of installations ordered were 10, but as at times messages were not correctly given, that might mean two, and it was thought best to be on the safe side, and not say too much about the quantity of the orders. He (the chairman) might add that practically the company's patent was the first in the field in Australia, which was a great advantage. Sir Julius complained that the dynamos and other equipments were not sent out quick enough to meet orders received. They were, however, being forwarded as fast as they could be manufactured by the parent company, and were now on their way to Melbourne, New Zealand, Sydney, and Western Australia. The board had made arrangements whereby they had obtained for £5,000 the option of purchasing what was known as the Sellon-Volckmar accumulator, should they feel eventually disposed to do so. He believed that it included the rights to the Faure accumulator in the colonies, but the Sellon-Volckmar had been admitted to be an improvement on the Faure. Resolutions were passed making certain alterations in the articles of association, in compliance with the requirements of the Stock Exchange.

YORKSHIRE (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Thursday afternoon, under the presidency of Mr. H. W. Lowe, the first ordinary general meeting of the shareholders of the above-named company was held at Cannon Street Hotel.

The notice convening the meeting having been read by the secretary, Mr. Morton,

The Chairman said: Ladies and gentlemen, you have heard the notice read convening this meeting, and I have no doubt you are all well aware that it is purely a formal meeting, held in accordance with the Act of Parliament, within three months of the formation of the Company. Of course, at such an early stage as this, we cannot be expected to report to you any substantial progress in the affairs of the company. Yet, at the same time, I hope what I shall be able to tell you will be found satisfactory, and perhaps encouraging. Of course our first endeavour has been to organise our staff upon an efficient, and at the same time strictly economical basis, and I am glad to tell you we have secured the services of a manager and also an electrician, who are thoroughly experienced and well able to perform their work; and as so much of the success of the undertaking depends upon these officials, I hope it will be found in the future that we have made a quite proper and sound choice in these gentlemen. We have opened offices at Leeds, that being the most convenient centre for the county. We have not gone to any large expenditure there; but there are the headquarters of our professional staff; and there they are close to their work, and ready for any business that they may be required to perform for the company. I need hardly tell that we, however, have received a great number of applications for estimates, and a great many inquiries for work; and I can only trust that some, indeed I trust that all, may result in business, of either large or small. So far, the progress we have made has been very encouraging indeed. We have set up one range of lights—one installation—at the Bradford Exhibition. We have 16 lights running there, and some incandescent lights, and these have given great satisfaction. The whole light has been exceedingly well spoken of by the local press. In a cutting from one, which I have before me—the *Bradford Observer*—the light is extremely highly spoken of indeed. It is, no doubt, a good advertisement for the company. Many mill-owners and others will have seen the light at work, and having seen the excellence of the light, they have only to prove the rest by inquiring the cost of the working and the results to be obtained from it. At Leeds, also, we have had an installation, which was seen at the meeting of the Institute of Mechanical Engineers—men who would be able to form an opinion upon a matter of this kind; and the universal verdict was certainly most satisfactory. The whole thing worked exceedingly well, thanks to the talent of our electrician, and nothing could have given greater satisfaction than that installation. We have one or two applications from Local Boards who desire the electric light in preference to gas. In some places there were quarrels between the gas authorities and the inhabitants, and where that is the case we take the advantage, and try to adjust matters by putting up a light for them. That is especially the case in one or two towns. I do not think it is wise or necessary to name them. If so the matter may reach these towns, and they may think we have overweening confidence of getting them within our range. The Act of Parliament passed recently has opened the door for the extension of the electric light, and it will be exceedingly valuable in the matter of the incandescent light; that is the house-to-house lighting, of which you have heard the full reports from New York regarding Mr. Edison's progress. At first it becomes a little irksome, because if any municipal corporation has any objection to their gas property being interfered with they have merely to refuse the application, and so set the electric light back months and months, until they apply to the Board of Trade for permission, which has to be further ratified by a special Act of Parliament. Of course the Act of Parliament can be obtained if the town or borough is worth the fight, but it requires time to do that. I hope we may be able to work these districts where some little opposition is shown without going into such a strong measure as an Act of Parliament. I think I have now given you some sketch of the work done; and if you had before you all the applications and inquiries we have had, you might form a little over-estimated idea of our ultimate success. But I do not wish to paint anything in a brighter light than it exists, and I take the facts as they stand. I hope our future, at the next meeting, may justify our expectations. I may add that I shall be glad to answer any question that a shareholder may wish to ask.

Rev. F. D. Rabbetts asked whether they had a quotation on the market yet.

The Chairman said that with reference to that he had merely to state that the Committee of the Stock Exchange was one of the most arbitrary bodies in the world. They laid down no fundamental rules that could guide outsiders as to what they would or would not do. An application had been made to the committee for a quotation, but at present they had not been favoured with an answer as to what they required or what the prospects were of the success of their application.

In reply to Mr. Turner, who asked what number of shares had been taken up, the Chairman said that the total was 61,633.

Mr. Turner further inquired how much had been paid on these shares.

The Chairman said that there had been paid £2 on each, with the exception of one or two very small amounts not yet paid after the allotment. £1 had been paid on application and £1 on allotment, and in one or two cases only the allotment money had not been paid. There were cases of people with small amounts of shares who had applied for a little time to pay the allotment money in, and as it had not been immediately required, time had been allowed for a month or two.

Mr. Turner apprehended that they had a large sum unemployed at present?

The Chairman said that there would have been, but they had just purchased largely in anticipation of undertaking a large installation at Middlesborough, where they expected, during the present year, to run certainly two, if not three, 40-light machines, which would be very remunerative to the company. They were just then a little barred by the action of the Middlesborough Corporation in refusing them the licence which had been applied for; but that matter had only been decided by the casting-vote of the chairman, and they hoped that in a short time the feeling would be so modified that they could get the licence without going through other formalities. If not, of course, they would have to go through these, because in such a town they could have a large and valuable connection. The inhabitants were strongly in favour of the electric light, in fact they seemed determined to have it whether the Corporation would or would not. In anticipating on an installation there, however, they had taken a lease of a small plot of land there, and had bought from the Brush Company the plant which would most likely be required, and which they had obtained at extra discount—which discount would represent a much larger sum than they could have obtained had they put their money out at 2 per cent., which was all they could obtain at that time for money at two or three weeks' call.

Mr. Maynard said that that being somewhat of an informal meeting, he might supplement the chairman's statement by saying that Mr. Bolckow, who was so well known, and who paid some £10,000 a week in wages, had remarked the other day to him, that having got the Brush system in his works at Middlesborough, he could not speak too highly of it. It enabled them to do many things which previously even a cloudy day had prevented them from doing. (Hear, hear.)

Mr. Hammond said that he would like to have one word before the meeting broke up. They perhaps had seen in a money article of to-day that his name had been connected with a new light, which would materially affect the interests of the Brush. He had felt it necessary to write a letter to the money article, which they would see in to-morrow's paper. But he would take the present opportunity of explaining the exact position which he held. They knew that the Yorkshire Brush held its rights from the Hammond Company, and that the Hammond Company got the control of an incandescent light which was becoming more and more important every day, and which would enable the Yorkshire to do its work five times more efficiently than it was doing it at present; it would be of course of great importance for the Yorkshire to acquire the use of it. The Hammond Company were always looking in the scientific world for whatever might be of advantage to the system, and help forward that great business. He wanted to say that they were in covenant with the sub-companies to give them the full benefit arising from such ideas as they judged would be of advantage.

Mr. Phillips in moving a vote of thanks to the chairman said that they owed much to the personal attention which the chairman had manifestly given to the subject.

The motion was seconded by Mr. Hastings and carried by acclamation.

The Chairman in replying said that he did not claim to have done more than his brother directors, but if personal attention and assiduous exertion could bring the company to success he believed they would succeed. They had the finest county in the country in their hands, and if the future of the electric light at all approached to what its friends believed, he was sure that their success could not be doubted. (Hear, hear.)

The proceedings then terminated.

THE TELEGRAPHIC JOURNAL AND

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MOTIVE-POWER FROM ELECTRICITY.

ALTHOUGH the idea of obtaining motive-power by the application of electricity is very old, and notwithstanding the fact that we possess at the present time such means of producing powerful currents as were quite unknown to the bygone race of electricians, yet the matter does not seem to have so much attention concentrated upon its ultimate solution now as it formerly did. This seeming want of interest is, no doubt, chiefly accounted for by the superior attractiveness, for the moment, of the electric light, so it is scarcely to be wondered at that the electric-motor is being worked upon by comparatively few. Had our predecessors possessed the dynamo-electric machines of our day, the problem of reducing to a practical and economical end the latent power of the waste forces of nature would have been solved. We must not, however, lose sight of what has been done by Messrs. Siemens and others of late years towards the practical development and use of electric railways; but the distribution of electric force for light work, such as actuating small lathes, &c., does not appear to have yet arrived at any definite solution. It has been stated over and over again what a boon such an application of electricity would be to the numberless workmen privately engaged in the mechanical trades, and who cannot afford to erect a steam-engine and boiler to supply their motive-power. Such a desirable method of securing an invisible but powerful ally cannot, however, fall to the lot of the British workman until, as in the case of electric lighting, central stations are established for electrical distribution on a large scale. Almost without exception electric lighting companies have the word "power" attached to their titles, yet we cannot call to mind a single instance of the application of electricity for such a purpose by any one company. It is somewhat surprising that an association has not yet been formed in England for supplying motive-power solely. With machines which will reproduce at a distance 60 per cent. of the horse-power developed by the driving engine, surely a profitable business might be insured to any company based on such a project, and we feel convinced that the venture would meet with the most favourable support.

The late Electrical Exhibition held in Paris gave sufficient evidence that such an idea is quite practicable, and it may be that the forthcoming exhibits at the Crystal Palace and the Royal Aquarium may produce something novel in this direction. Although private householders might not at first be induced to "rent" electricity for the purpose of driving the family sewing machine, yet there are innumerable instances of manufacturers employing dozens of these useful domestic articles who would certainly be well content to use electric power for the benefit of themselves and the operatives, who cannot but experience great fatigue in driving such machines throughout the long hours to which they are usually subjected. A company formed for this object would not be under the necessity of purchasing patents, as there are several good and simple motors which are free to every one, and the dynamo-electric machines can be obtained from numerous firms. Such extraordinary speculation has been indulged in during the present year, in connection with electrical matters, that we believe the public would strongly support a genuine movement for the general supply of electric power if kept free from electric lighting altogether. It is probable that the most successful start could be made in certain provincial towns rather than in the metropolis, but in either case the scheme appears perfectly feasible.

TESTING BATTERIES OF LOW RESISTANCE.

By H. R. KEMPE.

THE practical difficulties which are found to exist in carrying out the ordinary battery resistance tests, when these tests are applied to the measurement of batteries or accumulators of low resistance, are being continually experienced; some method, therefore, of overcoming these difficulties may prove useful. One fruitful source of error is no doubt imperfect connections from the terminals of the various cells not being properly cleaned or screwed up, whilst the resistance of the connecting wires themselves may introduce an error which cannot be ignored when the resistance of the cells is excessively small; for instance, the resistance of a single cell of an accumulator may be as low as ·001 ohm, that is about the resistance, of 12 inches of copper wire of No. 13 B.W.G. or 1-10th in. diameter. Supposing, however, that the proper precautions have been taken so as to avoid such errors as the foregoing we are confronted with other difficulties. It is pretty generally known by those who have had to make practical measurements that in order to take battery tests with anything like accuracy, it is necessary that one measurement be made with the battery connected to a resistance approximately equivalent to the resistance of the battery itself; thus in the well-known "half deflection" method we first connect the battery to a galvanometer of very low (and consequently negligible) resistance, and then having noted the deflection, we introduce into the circuit a resistance sufficient to reduce the deflection to that point which indicates that the current flowing in the circuit has been halved in strength; when this is the case the resistance added in the circuit is the resistance of the battery. Instead of reducing the current to one-half strength, it is sufficient to introduce sufficient resistance in the circuit to produce a decided diminution in the deflection, and then from the true deflections observed, and the resistance added in the circuit, the resistance of the battery can be determined by a simple formula. Another well-known method is to charge a condenser from the battery, and then to note the discharge; a second discharge is then taken with the battery shunted, and then the resistance of the battery is determined by a simple formula. Now, in order that any of these methods may be accurate, it is very necessary that the reduced deflection be a decided one. For instance, if the first deflection (on a Thomson's galvanometer, say) be 200 divisions, then the reduced deflection should not be less than 150 divisions, and preferably it should be as near to 100 divisions as possible. Assuming, however, that 150 divisions is sufficient, then this will mean that the battery is shunted by a resistance equal to three times the resistance of the battery. Now, supposing we tried to test a single cell of an accumulator having a resistance of ·001 ohm by this method, then when the shunt is inserted we should have a current flowing through the latter equal to

$$\frac{2 \text{ volts}}{\cdot 001 + \cdot 003} = 500 \text{ ampères},$$

a current sufficient to fuse, or at least, seriously heat (and

therefore change the resistance of) a resistance coil, even if the latter be very massively constructed, and be only connected to the battery for a very short period of time.

In order to reduce the strength of the current flowing in the circuit either the resistance in the latter must be increased or the electromotive force must be diminished. By the following simple expedient we can effect the required result: Take 11 cells, say, of the battery or accumulator to be tested, and divide them in two sets of 6 cells and 5 cells, and then connect up the two sets in series, but in such a way that the negative pole of one set be connected to the negative pole of the other set, then by this arrangement since the two sets oppose one another, the electromotive force of the whole combination will not be that of 11 cells, but of 6 — 5 or 1 cell, thus we have a battery with a resistance of 11 cells, but with an electromotive force of 1 only. If we make a test with such a battery or accumulator in the manner last indicated, then the shunt which would be used would have a resistance of $11 \times \cdot 003 = \cdot 033$ ohms, and the current flowing through it would be

$$\frac{2 \text{ volts}}{\cdot 011 + \cdot 033} = 45\cdot 5 \text{ ampères.}$$

It is evident that 45·5 ampères will produce a very much less heating effect than 500 ampères, more especially when we recollect that the heating effect varies as the *square* of the current.

We could, if we pleased, still further reduce the current by employing 10 good cells and 1 partially exhausted one, instead of 11 good cells.

As in any case it is not desirable that the shunt resistance should be exposed to the action of the current longer than is absolutely necessary, the best method of testing to employ would be Munro's.* The contacts (including the key contacts) should be made by mercury cups.

This method of dividing the battery and opposing one half against the other becomes still more practical in proportion as the number of cells to be tested becomes larger, since the greater will be the resistance in the circuit, and the less the current flowing.

If the two opposing halves of the battery be exactly equal, then the latter may be treated as an ordinary resistance and measured by the bridge method.

* See "Handbook of Electrical Testing." New Edition, p. 195.

THE JÜRGENSEN DYNAMO-ELECTRIC MACHINE AND ARC LAMPS.

THOSE of our readers who were fortunate enough to visit the electrical exhibition held in Paris last year will no doubt readily recall to mind the strangely shaped dynamo-electric machine of Profs. Jürgensen and Lorenz, of Copenhagen (better known as the Jürgensen machine), which stood, alone, at one end of the Palais de l'Industrie. The machine excited much curiosity not only on account of its curious structure, but also from the peculiar disposition of the field magnets. The arrangement of the armature and electro-magnet projections brings recollections of the machines of Fein, Heinrichs, and Schuckert. The subjects of the present article have, however, just been experimented with in London, and we therefore purpose giving a full description of Profs. Jürgensen's inventions together with several scientific reports on the efficiency of the machine.

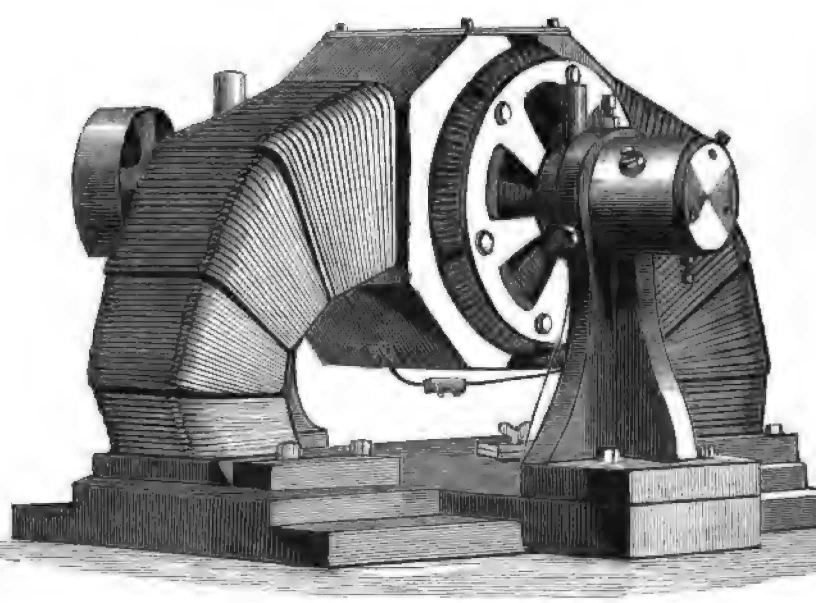


FIG. 1.

In our abstracts of published specifications columns for January 28th we gave an illustrated notice of this invention, which we reproduce further on, together with a brief extract from *La Lumière Electrique*, published in our "Notes" of February 4th. We have seen the Jürgensen machine and lamps in operation at the Cowper Street Schools of the Finsbury Technical College, and it has been subjected to numerous tests by Profs. Ayrton and Perry, whose reports we a[illegible]d to publish. In principle the machine is precisely similar to the well-known Gramme dynamo-electric machine, from which it differs in construction only. The revolving armature, or induced coil, is wound in exactly the same manner, and the arrangement of the commutator and brushes is likewise that of the Gramme, or very slightly modified. It will not therefore be necessary to say more on these points beyond detailing the way in which the armature is fixed, a way necessarily quite unlike the methods employed in other machines, and which will be found fully explained in the extract alluded to.

Fig. 1 shows a general view of the Jürgensen machine, while fig. 2 presents details of the arrangement of armature and electro-magnets. S, N, are the pole-pieces of the exterior field magnets, and *s*, *n*, those of the interior, E, E, which are fixed; the armature, therefore, runs freely between the poles of the exterior and interior electro-magnets.

Fig. 3 is a portion of the outside field magnet, and shows the method of coiling the wire to secure less heating effect, the convolutions not being closely wound side by side, as is usually the case, but each set of convolutions being slightly separated from its neighbours by the insertion of a little pin between them, as shown at A, A; the wire being represented by the straight lines.

We will now refer to our former description of this machine, which will enable our readers to understand fully the details of construction, both of the armature and the internal electro-magnets. "This magne[illegible] ...o-electric machine possesses, generally speaking, more ele[illegible]tromotive power than

any of the heretofore known machines acting on similar principles, and the total resistance of conduction in the machine is at the same time very insignificant. The weight

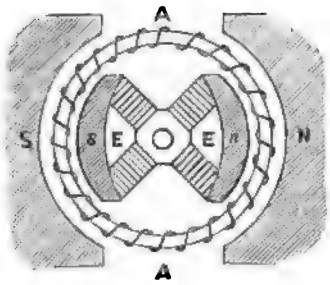


FIG. 2.

and dimensions of the machine are also small, having regard to the power of production. Fig. 4 is an end view; fig. 5 a vertical longitudinal section; and fig. 6 a detail view of a

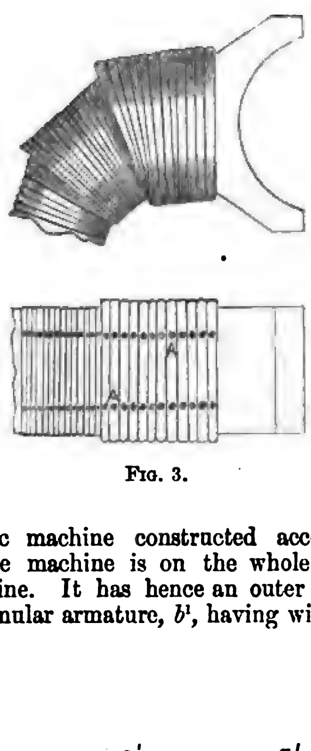
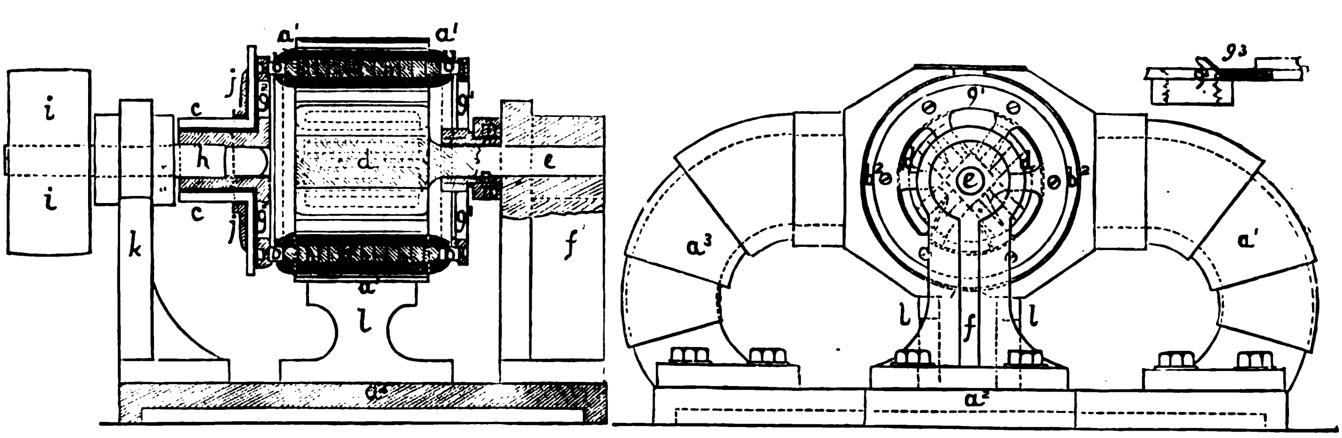


FIG. 3.

magneto-electric machine constructed according to this invention. The machine is on the whole similar to the Gramme machine. It has hence an outer electro-magnet, a^1, a^2, a^3, an annular armature, b^1, having wire coil sections, electro-magnet has a central gudgeon, e, which fits in a standard or bracket, f, and is held therein by screws, which, however, are not shown on the drawing, so that the north pole and south pole of the inner electro-magnet are opposite the north pole and south pole of the outer electro-magnet respectively. In order to further steady or secure the armature in its bearing in spite of the interior electro-magnet, there are unmagnetic rings, g^1, g^2, secured by studs projecting from the armature, b^1; of these rings one, g^1, has a central annular steel boss or ring which fits freely round the gudgeon, e, and has a projection, n, which works in the bearing, m^1, and the other ring, g^2, is fast on the spindle, h, whereby the armature is revolved and which consequently has a driving-strap pulley, i. The armature, b^1, is divided into a number of rings arranged side by side, separated from each other by insulating pieces, the whole being held together by bolts placed midway between the aforesaid studs, b^3. By this arrangement induction currents in the armature, b, are prevented in the length direction parallel to the axis; whereby is also attained that very long armatures (that is, in the axial direction) may be used in combination with one or more outer electro-magnets, whereby the power of the machine may be greatly increased. In order to prevent damage to the insulating pieces on the wire coils, b^2, and in the armature, b^1, itself by too great heat produced therein during the working of the machine through the unpreventable resistance to conduction, the spokes which unite the ring, g^1, at the gudgeon end with its boss or nave are chamfered off on the edges, and may also have little wings, g^3, as shown in fig. 6, so that by the revolution of the armature a cooling air current into the armature may be produced in its length direction. The outer electro-magnet of the machine really consists of two electro-magnets, a^1 and a^3, which by the iron bed plate of the machine are united to a single horse-shoe shaped electro-magnet. To prevent hurtful vibration of these two pole-parts, a^1 and a^3, they are steadied against each other at the top by an unmagnetic intermediate piece or plate, screwed thereto, and below by unmagnetic columns, l. In order to obtain the most powerful magnetism with the least conduction resistance, the wire coils are accumulated to the greatest extent near the pole-pieces of the electro-magnet. The electric current to the inner and to the outer electro-magnet may either be taken from the main current of the machine itself, or from a less number of separate wire sections on the armature of the machine, or lastly, from another smaller electro-magnetic machine. The contact cylinder, c, or commutator, consists of angle-shaped copper



FIGS. 4, 5, AND 6.

b^2, and rotating between the poles of the electro-magnet, a contact cylinder, c, at one end, and brushes for collecting the electric current developed. The powerful action of the machine is mainly attained by the application of a central electro-magnet, d, inside the annular armature, b^1, b^2; this electro-magnet is, so to say, formed as two bar magnets placed crosswise, and having the north poles as well as the south poles respectively united by pole-piece; this interior bars, which by a disc or ring, j, are fastened to the ring, g^2, which is fast on the spindle, h, but of course with insulating pieces between the said bars and the ring, g^2, and its centre boss, and the disc, j. The collecting brushes are not shown on the drawings, as they are of the usual form. They are arranged on the spindle-bearing bracket, k, so that they by being turned round the centre line of the spindle, h, may be set according to the neutral axis of the machine."

The special features claimed, we believe, for the Jürgensen machine are: the application in dynamo-electric machines of an electro-magnet within the revolving armature, with or without the use of external electro-magnets; the use of annular armatures made up of a series of sections of narrow rings insulated from each other; the special mode of ventilating and cooling the machine by means of the fan or wings attached to the ring at the end of the armature; and the special form of outer electro-magnet. At the time of the Paris Exhibition we were unable to obtain any data whatever respecting the performance of this machine, although it was claimed that for its size it was the most powerful dynamo-electric machine made. However, soon after the exhibition, some remarks of a critical nature concerning Professor Jürgensen's invention were published in the columns of *La Lumière Electrique*, from the pen of M. Guerout, which read as follows:—

"What constitute the really original part of the Jürgensen machine are—1st, the electro-magnet in the interior of the armature; 2nd, the particular mode of winding the wires of the inductors, and the strong ventilation which the rotation of the armature provokes. This last point, as well as the empty spaces left between the wires of the electro-magnets is advantageous because it lessens the heating of the machine. The concentration of magnetism in consequence of the coil on the polar appendages, is also not without advantages, but the rounded form given to the inductors does not seem to us very logical so far as construction is concerned. From this point of view also, we shall criticise the manner in which the interior inductors are supported, being maintained only by one extremity of their axis. In this position the weight of the electro-magnets must tend to bend the support and to put the machine out of order. Besides, these interior electro-magnets had already been employed by M. Siemens, but with an armature coiled with wire on the outside only, and M. Jürgensen maintains that the presence of the wire in the interior of the ring considerably increases the inductive action in proportion to the action of the interior magnets; we do not, however, think that this is the case. It seems to us that the induction is produced principally by the pole developed in the revolving ring of iron by the inductors, and it matters little whether this pole is caused by the outer electro-magnets alone, or by inductors placed about the interior and exterior. This theory is confirmed by the fact that Fein's machine (see *La Lumière Electrique*, July 13th, 1881), which also possesses interior induction, has not given better results than the Gramme machine. As to the Jürgensen machine, as far as we know, no experiments have been made with it at the Exhibition by which we might judge of its pratical value. The analogy which exists between it and the Fein machine, as regards the manner in which the ring is influenced by the inductors leads us to think that it will give results little different to those obtained from the latter."

M. Guerout had evidently ignored the fact that although interior induction is employed in Fein's machine, the inside pole-piece is merely a prolongation of the exterior, so that the intensity of magnetism in the core of the armature would probably be somewhat weaker than if the exterior only had been used, by reason of the given magnetism in the inductors being spread over a much larger mass of iron. The Jürgensen machine therefore differs from the foregoing, inasmuch as the magnetism in each pole-piece is independent of the other, or in other words, the inside and outside poles are magnetised individually and are not connected together as in Fein's dynamo-electric machine.

We are now in a position to place before our readers such information as will enable them to form their own judgment as to the efficiency of the Jürgensen machine. The first report on its performance is that of Mr. Lund, of Copenhagen, a copy of which we give below. He also alludes to the lamp employed in connection with the machine we are speaking of, and which we also describe and illustrate in the present article.

[COPY.]

The dynamo-electric machine constructed by Professors Jürgensen and Lorenz is remarkable for simplicity in construction, and is therefore very easy to manufacture.

It has the advantage of requiring less driving power relative to the strength of the current obtained, and can therefore be produced at a less cost, and does not become heated.

The coils on the rotating armature are influenced both from the inside and the outside, that is, through their whole length, and thereby there is the advantage that the machine may be constructed proportionately smaller than other machines, and demands less driving power. The inner magnet counteracts the inclination of the outer one to form inductive currents in the armature, as it will itself form such currents in an opposite direction, thus again saving driving power and arresting the production of heat by these currents. Besides which the armature is in heat-conducting connection with the bulk of the machine, for which reason the heat arising in the bobbins cannot ever become very great, as it is continually being absorbed. Further, the coils on the ring are kept cool by a current of air entering at the armature during the rotation of the machine.

The shape of the outer magnets and the way of coiling assist to produce a strong magnetisation as compared with the small amount of coil.

The construction of the machine greatly facilitates any repairs that may be necessary at any time, as both the inner magnet and the rotating armature can be taken out, each separately, without removing the magnets.

The differential lamp constructed by Professor Jürgensen is distinguished for simplicity of construction and quiet and steady light. This is obtained by the way the carbons are kept in the same distance one from the other, which is effected by making the magnetic power of the two solenoids in connection with the carbon-holders always balance one with the other, and no use is made of any mechanism or clockwork whatsoever.

As far as I am aware, the machines and lamps constructed by Professor Jürgensen can be made cheaper than any other, both by reason of their simplicity of construction and easiness of fabrication.

(Signed) L. LUND,
Manager of Works at the Mechanical Establishment of Prof. E. Jüngers, Copenhagen.

Then follow two reports by Professors Ayrton and Perry, which will be found specially interesting.

PRELIMINARY REPORT ON THE JÜRGENSEN DYNAMO-ELECTRIC MACHINE AT MESSRS. JOHNSON AND PHILLIPS' WORKS, CHARLTON.

By Professors W. E. AYRTON and JOHN PERRY, M.E.

LONDON, 1*st August*, 1882.

This machine is what is known as a "series dynamo," that is, the field magnets are in series with the revolving armature.

The two specialities of the machine are—1st, an internal fixed electro-magnet, which together with the external fixed electro-magnet produces the magnetic field in which the armature revolves. 2nd, the special shape given to the external magnets causing them to follow the lines of magnetic force, and therefore theoretically enabling them to produce a stronger magnetic field for the same strength of current and number of convolutions of wire.

Both these specialities in the machine are advantageous in enabling a strong magnetic field to be created, and therefore a high electromotive force.

We made certain tests of the current and electromotive force produced by the machine running at different speeds, 1st, when two arc lamps were in circuit; 2nd, when one arc lamp was in circuit; and lastly, when various resistances were introduced, and the following are the results we obtained:—

No. of revolutions per minute.	Current in ampères.	Electromotive force in volts between the terminals of machine.	Approximate total electromotive force of the machine.	Resistance in the external circuit in ohms.	Remarks.
800	17·3	78·3	126		2 arc lamps burning in circuit
840	18·1	97·2	148		" " "
550	15·4	58·0	101		One
620	14·3	65·3	106	4·5	
610	16·4	54·5	103	3·3	
620	20·7	43·8	102	2·1	
560	24·2	28·1	97	1·2	
630	25·8	29·0	103	1·2	

If the last set of observations be reduced all to the same speed, 620 revolutions per minute, the total electromotive force becomes:—

106 volts.
105 "
102 "
107 "
103 "

From this it is seen that for currents in the field magnets varying from 12 to 26 ampères, the total electromotive force is nearly constant, which shows that for the smaller current the field magnets are already satiated. Hence less wire might advantageously be used on these magnets, producing a resistance less than 1·1 S. U., which, we are informed, was the resistance of the internal and external field magnets together; that of the revolving armature being, we were informed, 1·75 S. U.

The greatest power electrically developed by the dynamo during the preceding experiments was 3·6 horse-power, and the greatest horse-power usefully electrically developed, that is developed in the external circuit, was 2·4.

We were not able to judge of the efficiency of the machine, that is the proportion of the horse-power electrically developed by the dynamo to that given to it by the steam-engine, because there was no transmission dynamometer available, or arrangements for taking indicator diagrams of the engine.

It is most important, in order to judge of the commercial value of the Jürgensen dynamo, that dynamometer tests of the transmitted power should be made simultaneously with those of the electric power given out by the dynamo, or if time does not allow of a transmission dynamometer being obtained and fixed in position, that the cylinder of the engine should be bored for the insertion of an indicator, so that indicator diagrams may be taken simultaneously with the electric tests.

REPORT ON THE JÜRGENSEN DYNAMO MACHINE AND LAMP.

68, SLOANE STREET, S.W.

September 4th, 1882.

WE have made a large number of experiments with this machine at different speeds, and sending currents through various resistances. In each case there were measured—

1. The horse-power actually given to the dynamo.
2. The speed of rotations of the dynamo.
3. The current in ampères generated.
4. The electromotive force in volts set up between the terminals of the machine.

We find that for currents of over 15 ampères at the lower speeds of 500 to 600 revolutions per minute, and for currents of over 12 ampéres at the higher speeds of 750 to 950 revolutions, the efficiency of the machine was half, or more; that is to say, for every horse-power given by the engine to the dynamo at least one-half a horse-power was electrically given out by it, part of this being given out in the external circuit, and part appearing as heat in the armature and field magnets of the machine itself.

At a speed of 790 revolutions per minute, when the external resistance was equal to 3·9 ohms, the efficiency of the machine reached 0·93 and the useful efficiency to 0·54, that is to say, of the horse-power given by the engine to the dynamo 93 per cent. was given out electrically by the dynamo, 54 per cent. appearing in the external circuit.

In this case the actual horse-power given to the dynamo was 4·9, of which 4·6 was reproduced electrically by the machine, 2·6 of this appearing in the external circuit.

At a speed of 930, with 8·7 ohms in the external circuit, the total efficiency of the machine was 0·77, and the useful or commercial efficiency to 0·58, or nearly six-tenths of the total power given to the dynamo was reproduced electrically in a useful manner in the external circuit.

In this latter case, a current of 14 ampères was sent through the external resistance of 8·9 ohms. Now, when two of Mr. Jürgensen's lamps were in circuit we found the external resistance to be about 7 ohms and a current of about 14 ampères to give the best results after the lamps had been adjusted by the gentlemen who represented the inventor.

Hence under the ordinary conditions of burning the Jürgensen machine may be expected to have a total efficiency of about 0·8, and a useful or commercial efficiency of about 0·6 may be expected in the external circuit.

A sample of some of the results obtained follows:—

Rates of power appearing usefully in external circuit to power given to dynamo.........	0·44	0·54	0·58	0·58
Rates of power given out by dynamo to power given to dynamo	0·85	0·93	0·84	0·77
Horse-power appearing in the external circuit	2·4	2·6	2·6	2·4
Horse-power given out by dynamo	4·5	4·6	3·7	3·1
Horse-power given to dynamo by engine	5·3	4·9	4·5	4·1
Total electromotive force produced by dynamo in volts..	141·6	150	160	165
Electromotive force produced in the external circuit, in volts............................	73·8	88·2	109·8	124
Current in ampères	23·8	22·4	17·5	14·3
Resistance in the external circuit in ohms	3·6	3·9	6·2	8·7
Speed of dynamo, number of rotations per minute.........	744	790	848	930

In order to determine the efficiency of the lamp, that is, the number of standard candles illuminating power per horse-power electrically given to the lamp, the current passing through it was measured in ampères, the electromotive force between the terminals in volts, and simultaneously the illuminating power.

The beam of light coming at different angles in succession from the lamp was received in the photometer, and several measurements were made at each angle. Negative angles mean that the lamp was below the photometer, and therefore sending rays up, while the positive sign before the angle indicates that the lamp was above the photometer and therefore sending the rays down.

The light was examined through red glass as well as through green glass, in order to compare its intensity with the red light of a standard candle and with the green light.

The more important of the results of the measurements are contained in the following table.

Current in amperes.	Electromotive force in volts between the terminals of one lamp.	Horse-power electrically given to lamp.	Angle of elevation.	Intensity of light in standard candles. Red.	Intensity of light in standard candles. Green.	Standard candles per horse-power. Red.	Standard candles per horse-power. Green.
16·5 to 17·9	44·3 to 48·6	1·04 to 1·14	—32°	205 to 223	436 to 491	197	414 to 462
15·8 to 16·8	48·6 to 49·7	1·03 to 1·12	—10°	179	321 to 365	174	295 to 326
16·1 to 17·2	47·2 to 54·4	1·06 to 1·17	0	488 to 558	526 to 579	425 to 500	496 to 677
14·7 to 16·1	47·5 to 51·1	·98 to 1·05	+ 7°	322 to 348	724 to 788	316 to 332	738 to 783
17·15	45	1·035	22½°	620	1863	602	1795
17·5 to 18·2	48·6 to 51·1	1·15 to 1·24	34°	1127	2242 to 2415	951	1937
14· to 14·7	41· to 42·5	·797 to ·808	40°	503	1179	622	1480
14·7 to 16·1	46·8 to 51·5	·97 to 1·03	„	841 to 916	2471 to 2518	871 to 916	2434

The lamp burnt steadily, and with proper resistances given to the three solenoids the feed of the carbons could be made extremely regular, and the light therefore very constant.

(Signed) W. E. AYRTON.
JOHN PERRY.

We made a few observations last week in an article concerning the faulty designing of dynamo-electric machines which often occurs, and a case in point crops up in the first report of Messrs. Ayrton and Perry. The electro-magnets in the Jürgensen machine might, it will be seen, have been as powerful with considerably less wire coiled upon them

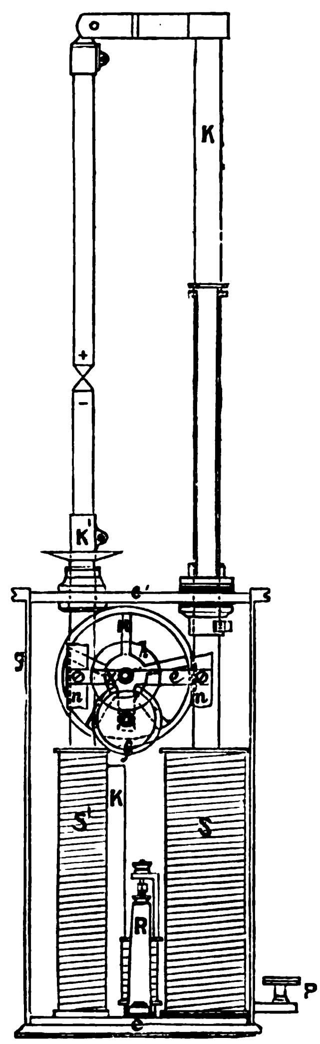


FIG. 1.

and it was this particular example that we hinted at to the effect that it would probably be shortly brought before the notice of our readers.

It follows, then, that the machine can be made equally effective at a smaller cost than as now constructed. Professor Jürgensen's lamp of the arc type and of fixed focus is illustrated in the drawings herein annexed, both in detail and in full.

Fig. 1 is a side elevation, figs. 2 and 3, elevations of details, and fig. 4 a diagrammatic view of the arrangement.

The two carbon-holders, K′, K, are respectively supported by two grooved circular discs or pulleys, h and H, fixed on a common axis carried by the frame work. When either carbon is raised, the axis, x, and discs are turned, whereby the other carbon-holder is lowered, and *vice versa*.

The carbon-holders are guided by suitable bushes in the plate, C^1, forming the cover of the case, g, and by the solenoids, S^1 and S, into which they are extended by means of rods of soft iron. The radii of the above-mentioned discs, H and h, are made proportionate to the lengths of carbon that are burnt away during the same period of time, from the upper and lower carbon points respectively, so that the arc is always maintained in the same place in the lamp.

The two solenoids, S^1 and S, are connected together by the binding screws, P and P^1, a contact apparatus, R, and the carbon-holders, K^1 and K, as shown in fig. 4.

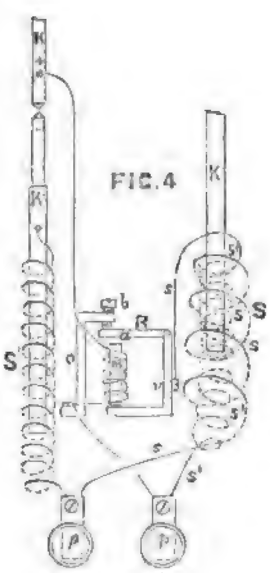


FIG. 4

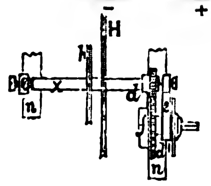
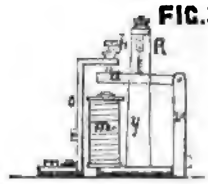


FIG. 2

FIG. 3



Before the lamp is connected with the wires, a movable armature, A, in the contact apparatus, R (figs. 3 and 4), will always be held in contact with an adjusting screw, B, in an insulated carriage, O, by a spiral spring attached to the carriage, Y.

Supposing the carbon points to be so far removed from one another at the moment when the electric current is admitted to the apparatus, that no luminous arc can be formed between them, a part of the current will pass from a binding screw, P^+, through the insulated carriage, O, the adjusting screw, B, the movable armature, A, the insulated carriage, V, the outer coils of the wire, S, in the solenoid, S, to another binding screw, P^-.

The upper carbon-holder, K, is thereby drawn downwards into the said solenoid, S, and the lower carbon-holder, K^1, is raised by the action of the discs, H, h, as above explained until a luminous arc is formed by a branch of the current which then passes through the first-mentioned insulated carriage, O, the solenoid of an electro-magnet, m, to the upper carbon, and thence through the arc, the lower carbon and the solenoid, S^1, surrounding that carbon to the binding screw, P^-.

As soon as the current has thus branched off the armature, a, is attracted by the before-mentioned electro-magnet, m, and the current from the insulated carriage, V, of the said armature to the outer coil, S, of the upper carbon solenoid, S, is broken.

The upper carbon solenoid, S, now only receives a branch of the current which, from the moment the current enters the lamp, passes from the binding screw, P^-, up through the outer coil, S, of the upper carbon solenoid, then through another finer coil, S^1, within the first-named, back to the binding screw, P^+.

The magnetic attraction of the upper carbon-holder, K, effected by this branching of the current, counteracts the attraction of the lower carbon-holder, K^1, by the lower

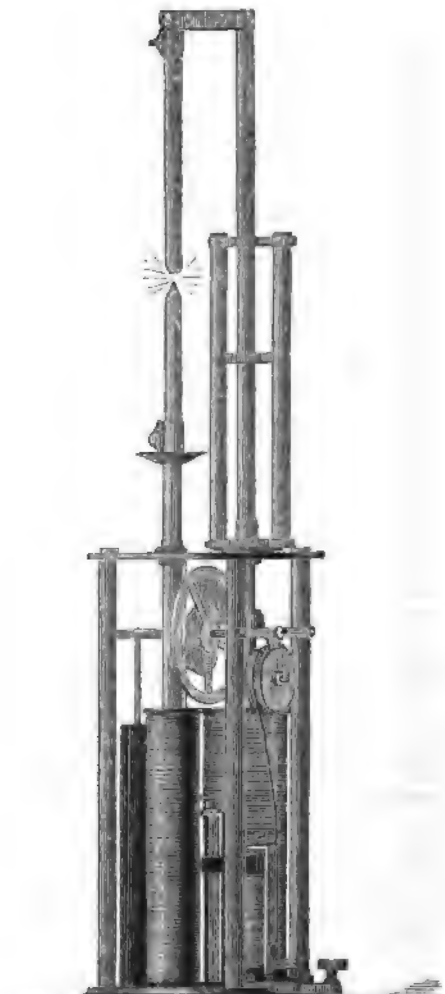


FIG. 5.

GENERAL VIEW OF LAMP.

carbon solenoid, S^1, and the current in the upper carbon solenoid, S, becomes proportionally stronger, consequently the carbon points approach one another till the normal condition of the currents in the solenoids is re-established.

When the luminous arc becomes shortened from any cause the current in the lower carbon solenoid, S^1, becomes stronger, while that in the upper carbon solenoid, S, becomes weaker, and the carbon points will be separated further apart.

In order to regulate or reduce the movements of the carbon-holders so that no objectionable unsteadiness of the light shall occur, one of the carbon points is connected with the piston rod of a hydraulic brake, K. To enable the lamp to be used with currents of different tension, the axis, X, of the discs is connected by a toothed pinion, d, and wheel, d, with an enclosed spring, F. By regulating the tension of this spring as required, the said axis, X, can be balanced to suit any particular case.

The lamp may be arranged so as to hang down, but in

that case the mechanism must be so adapted that the carbon points are placed below.

The claim in this lamp is for the use of two solenoids, S and S', each working direct on their respective carbon-holders, K and K'.

The English patents for the machine and lamp are dated as follows:—No. 2416, 1881, dated June 1st, and granted to Frederick Wolff, and No. 3385, dated July 17th, 1882, granted to L. A. Groth.

In our concluding remarks we may add, that the machine we have described, constructed to produce 21 lights of 2,000 candle-power each, is comparatively small, its base being 28½ inches in length, and 21½ inches in width, across its middle, (the widest part). The armature is about 10½ inches in diameter, and the length from end to end of the supporting rings, 9 inches.

The peculiar fixing of the armature and the internal electro-magnet may be thought a weak point, but we understand that a well-known mechanical engineer whose name we are not at liberty to give, considers it perfectly safe, and his opinion in such matters is certainly a sufficient guarantee. The cost of this machine in Copenhagen is about £33, so it appears that a considerable demand for such a powerful dynamo-electric machine will probably result, as its selling price should be much less than others in the market. A large machine for the Danish Government, producing a light of 25,000 candle-power, cost in Copenhagen only £55 to manufacture.

We consider this machine an excellent one, and its efficiency stands very high indeed. The lamps do not strike us so favourably, being somewhat clumsy, but their regulating action is very good, and with a better mechanical design there would be little fault to be found. Indeed, we have learnt since our inspection of Prof. Jürgensen's inventions, that these lamps are not intended to exemplify the best form that can be obtained, and that others of a superior character are being manufactured abroad. In regard to the patents, we are informed that the opinions of competent judges, is to the effect that the Jürgensen system does not infringe others.

The following is a list of some of the places where the Jürgensen system of electric lighting has been adopted and fitted up.

By the royal Danish Government for the use of the royal engineers and the royal artillery corps; the spirit works at Roskilde; the brewery "Albani Odense;" the brewery "Gl. Carlsberg," Copenhagen; the brewery "Ny. Carlsberg," Copenhagen; sugar works, Nakskow, Copenhagen; "Det-forende Dampskibselskal" Steam Ship Company, Copenhagen; the Danish spirit works, Copenhagen.

Besides the above, concessions have been granted to Mr. Groth, the representative of the system in England, to fit up the system at the Royal Palace at Stockholm; most of the principal streets in Stockholm; the town of Malmo, Sweden; the town of Wexio, Sweden; the town of Christianstad, Sweden; the Café Bauer in Berlin; Fridrich Strasse in Berlin, &c., &c.

THE BRITISH ASSOCIATION.

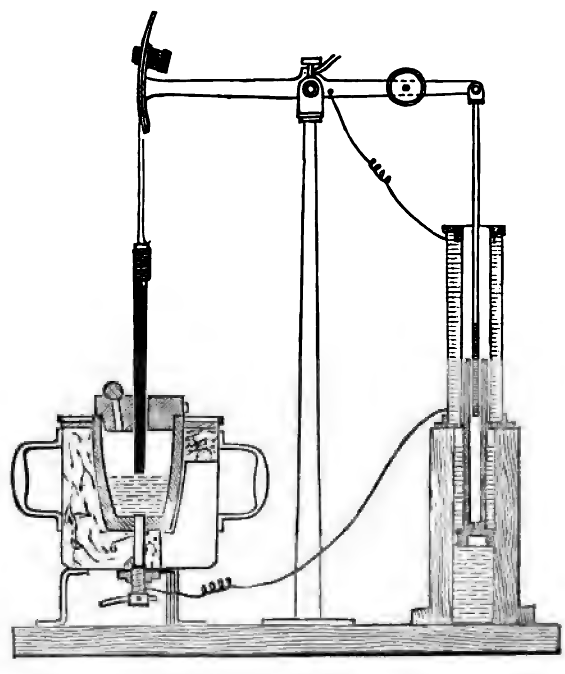
ON THE ELECTRIC FURNACE.

By C. W. SIEMENS, D.C.L., F.R.S., and A. K. HUNTINGTON, Professor of Metallurgy, King's College, London.

[Read before Section B of the British Association at Southampton.]

THE electric furnace has previously been described in the *Journal of the Society of Telegraph Engineers*, June, 1880. It has since been found advisable to surround the furnace with a coil. By this means the direction of the arc can be regulated at will, and the tendency which it has to fly to the sides of the crucible be checked.

The furnace consists of a crucible of any convenient size, in the bottom of which is pierced a hole to receive the positive electrode, the negative electrode, which passes through a hole in the lid of the crucible, being suspended from one end of a beam, the other end of which is attached to a hollow cylinder of soft iron, free to move vertically within a solenoid coil of wire. The force with which the cylinder is drawn into the coil can be counterpoised by a sliding weight on the beam. One end of the solenoid coil is connected with the positive, and the other with the negative pole. The coil having a high resistance, its attractive force on the cylinder is proportional to the electromotive force between the electrodes, *i.e.*, to the resistance of the arc. The length of the arc is, therefore, regulated automatically. This is a point of great importance, as, were it not so, the resistance of the arc would rapidly diminish as the temperature of the atmosphere within the crucible increased, and the result would be that heat would be developed in the dynamo machine. The extinction of the arc by sudden change in its resistance or by the sinking of the material in the crucible is thus also avoided. The crucible is surrounded with some infusible substance, which is also a bad conductor of heat. Gas retort carbon or sand answers well for the purpose. The electrodes may be of such carbon as is used in electric lighting or of any other convenient conducting substance. They may, if desired, be cooled by circulating water through or round them, or by exposing them as far as possible to the air. For example, in one experiment a ½-in. nickel positive pole was employed, the lower end being inserted into a solid rod of copper about 1 in. square by 6 in. long. With this pole, no other means of keeping it cool being adopted, 1 lb. of grain nickel was fused in a clay crucible and poured in eight minutes, starting with all cold. The electrode was but little attacked, and no leakage occurred.



There are two great advantages possessed by the electric furnace, viz., that the temperature attainable is practically only limited by the refractoriness of the materials of which the furnace is constructed, and that the heat is developed immediately in the material to be fused, instead of first having to pass through the containing vessel. The temperature to be obtained by the use of fuel is limited by dissociation. Deville has shown that carbonic acid undergoes dissociation at the ordinary atmospheric pressure at about 2,600 deg. Cent.—4,700 deg. Fah.

In the experiments made by the authors, five D 2 machines driven by a Marshall's 12 horse-power engine were employed, one being used as an exciter. The current ranged between 250 and 300 ampères. The most refractory clay crucibles supplied by the Patent Plumbago Crucible Company were invariably cut through in a few minutes, and, except for experiments of short duration, were useless. Plumbago crucibles stood exceedingly well. Obviously, however, they could not be employed for all purposes, owing to their tendency to cause carburisation of the metal experimented with. In some experiments the fusion of metal was effected in a bed of lime, sand, or electric light carbon dust. The latter is a very bad conductor, and, as in the case of lime and sand, allows the arc when once formed to maintain a passage through it to the metal beneath.

Wrought Iron.—Six pounds of wrought iron were kept under the action of the arc for twenty minutes, and the metal then poured into a mould. It was found to be crystalline, and could not be forged. This is the result which has always been obtained when iron, nickel, or cobalt have been fused. Although the remedy, viz., the addition of a little manganese just before pouring, is well known, the cause remains still unexplained.

Steel.—As much as 20 lb. of steel files have been melted in one charge, the time required being about one hour, starting with the furnace hot. With such large quantities the metal has invariably been full of blowholes.

White iron, fused in a clay crucible for thirty minutes, when fractured did not appear to have undergone any change. White iron and coke were introduced into the furnace; the resultant metal was slightly greyer than the original. When, however, retort carbon was substituted for the coke a good grey iron, soft and easily workable, was readily obtained in fifteen minutes, starting with the crucible hot. On another occasion, starting all cold, at the end of thirty minutes the metal, although it had been well fused, had not been rendered greyer. The difference between these two results was possibly due to the temperature being somewhat higher in the one case than in the other. This is a point of considerable practical interest. Four pounds of white iron, fused with carbon dust for three-quarters of an hour, yielded a very grey crystalline iron. In

another experiment, in which 8 oz. of grey iron, produced in the electric furnace from white iron, were remelted in carbon dust for ten minutes a very grey metal was obtained, from which on slow cooling a large quantity of graphite separated.

Cast iron, fused and kept under the action of the arc for forty-five minutes in carbon dust, was not materially changed as to greyness, and the general character of the metal as to the way in which it worked under the tool was not materially altered. The object of the experiment was to ascertain the maximum amount of carbon iron is capable of taking up under circumstances presumably the most favourable. The result is hardly that which would have been anticipated. Some of the same cast iron was fused for fifteen minutes under lime, which nearly covered it. The character of the fracture of the metal was but little altered by this treatment, when slight differences, due to the rate of cooling, are taken into account. A strong smell of phosphoretted hydrogen or of a phosphide was perceived—probably the latter. This was only observed in the experiment in which lime was used. The lime employed still retains a very offensive odour.

When *spiegeleisen* was fused in a plumbago or a clay crucible graphite separated as the metal cooled.

Siliceous pig iron, containing about 10 per cent. silicon, was fused by itself; it showed but little change, except that some graphite was separated. A similar result was obtained when 5 lb. of the siliceous pig were fused for one hour in carbon dust. On fracturing the ingot obtained, a large quantity of scales of graphite was found in a hollow which traversed nearly the whole length of the ingot at its centre. The fracture of the metal was still that so characteristic of highly siliceous iron, and was practically the same as that of the original pig iron.

A series of experiments was made to determine the maximum amount of carbon pig iron is capable of taking up in the presence of a given quantity of silicon. Grey cast iron and pig iron containing 10 per cent. of silicon were fused together in carbon dust, the ratio between them being varied so as to yield metal with from ½ per cent. to 9 per cent. of silicon.

A similar series was made, only substituting sulphur for silicon. No odour of sulphurous acid was perceived; therefore, presumably, no sulphur was volatilised. This is somewhat remarkable, considering the nature of the experiment. It was thought that investigations of this kind might have an important practical as well as more purely scientific interest—admitting, for the sake of argument, that any such distinction really exists—in assisting to determine the conditions in the blast furnace, &c.

Nickel.—A positive pole of this metal—cast malleable by Wiggin and Co.'s process*—½ in. in diameter, was passed through a hole in the bottom of a clay crucible. A carbon negative pole was used, but soon after the commencement of the experiment a deposit of nickel formed on the end of it, so that practically it was a nickel pole. This deposition of metal on the negative pole was also observed with some other metals—notably with tungsten. Whilst disclaiming any special knowledge on the point, Professor Huntington suggested whether this phenomenon—which is the reverse of that generally recognised as taking place—might not depend on the relative volatility of the matter composing the poles. In the furnace arranged as just described, 1 lb. of grain nickel was fused and poured in eight minutes. The fused metal had a brilliant granular fracture. It could not be cut properly in the shaping machine, shearing off under the tool. One pound of grain nickel, fused in carbon dust for twenty-five minutes, yielded a dark gray carburised metal, which worked well under the tool. On another occasion an equal quantity of nickel, similarly treated, gave a "blowy" metal, which could not be worked. Some carburised nickel, made as described above, was fused in a clay crucible for twelve minutes, and allowed to cool gradually in the furnace; the fracture became whiter, and the grain closer.

Copper.—Three quarters of a pound of copper were fused for about half an hour in carbon dust. On examining the result, it was found that all but about ⅜ oz. had been vapourised. Those who were present during the experiments suffered no ill effects from the atmosphere charged with copper which they must have breathed.

Platinum.—Eight pounds of platinum were rendered perfectly liquid in about a quarter of an hour.

Tungsten.—Half a pound of tungsten in powder was subjected to the action of the arc in a clay crucible. Dense fumes were evolved, a cavity about 1½ inches across the top being formed. The furnace was allowed to cool down slowly. When the crucible was removed it was found to have been very much attacked below the point to which the arc extended. The inference is that the crucible had been attacked by the metal at the temperature of the experiment. The metal was fused only to an inappreciable depth beneath the cavity formed by the arc. The unfused metal underneath was covered with very beautiful iridescent crystals of tungsten, which under the microscope appeared to be well-formed prisms. They have not yet been measured. The crystals had evidently been formed by the slow cooling of the vapour distilled down from the surface.

A very large number of experiments was made with tungsten, the results of which showed that it could not be fused, except in very small quantities at a time. It was possible to build up a small ingot by fusing a little of the tungsten, and then adding little by little gradually. Even then the pieces obtained were for the most part spongy and unsatisfactory. The best results arrived at were when tungsten which had already been fused was employed in the building-up process. Once the metal had been fused it did not fume much in melting, doubtless owing to the greatly reduced surface exposed.

Tungsten fused in the electric furnace is, when untarnished, pure white, and brittle, the grain being very close. Tungsten hitherto has only been obtained, as a gray powder, by reducing the oxide with carbon or hydrogen, or in minute globules, in the ordinary small electric arc. Tungsten has its fusing point lowered by the addition to it of carbon. Under these conditions a solid piece of moderate size can, without much difficulty, be obtained. From 1000 grains of powder fused in carbon dust 650 grains were recovered, the remainder having been volatilised, and from 450 grains of the fused metal 410 grains were obtained on refusion. One piece of tungsten which had been treated under the conditions most likely to cause it to be highly carburised was analysed. It contained 1·8 per cent. of carbon. The metal was very white, close in grain, and brittle.

From the foregoing experiments it is clear that the amount of any given metal which can be successfully fused in the electric furnace, and the time required in effecting the fusion, are dependant on (*a*) the relation between the volatilising point and the fusing point, *i.e.*, the extent to which the volatilising point is higher than the fusing point; (*b*) the conductivity of the metal for heat.

It thus happens that platinum can be more readily melted than steel, and in greater quantity for a given expenditure of energy. This inference is believed by Professor Huntington to be justified by the observations and experiments so far made.

It still remains to examine chemically the specimens referred to in this paper.

In the discussion on the communication made by Professor Huntington, Dr. Siemens remarked that the limit of the temperature producible by means of the electric furnace is as yet unknown, for although the heat would probably increase the resistance of the arc, that in itself would only cause a further development of heat. The results obtained with copper, although apparently pointing to a drawback in the use of the furnace for melting purposes, yet might prove of importance in dealing with metals in the vaporous condition. He could not agree with Professor Huntington's suggestion as to the cause of the deposition of metal on the negative pole. He thought it was due to the negative pole being much cooler than the positive.

Dr. Gladstone inquired whether the deposit was crystalline or in fused globules.

Prof. Huntington replied that it was in the latter condition.

Mr. Terrill (Swansea) remarked that the loss of copper by volatilisation in smelting was much greater than it was generally supposed. During an accidental escape of sulphuretted hydrogen in the works he had observed a thick deposit of sulphide of copper extending over a large area. He had detected copper deposited even on the zinc counter of the refreshment bar at the railway station some distance from the works. The discussion was continued by Mr. Maxwell Lyte, Prof. Vernon Harcourt, and the president, Prof. Liveing, who thought that such experiments as had been made might be of great service in the study of metals.

* See paper on "Nickel and Cobalt" by H. K. Huntington, in July number of the *Journal of the Society of Chemical Industry*.

ELECTRO-MOTORS.

WE illustrate below two electro-motors, one of which (fig. 1) will be readily recognised as that of the well-known Griscom apparatus. The subject of electrical transmission of power we have touched upon in our other columns.

It is well known that a dynamo machine is reversible, that is, if a current be sent through its coils, the armature will revolve at a greater or lesser speed, according to the current strength. This fact led inventors to turn their attention to some simple means of converting the current from galvanic batteries into power; and many attempts were made, more or less successfully, to get a small but powerful engine driven economically by battery power. This matter has long been worked at by an American inventor, Mr. William W. Griscom, of Philadelphia, who has given much time and money to the perfection and manufacture of an electro-motor, which is styled, for reasons enumerated below, the "double induction motor." The construction and action of Mr. Griscom's motor is thus described:—

"The machine consists simply of a small Siemens' armature, revolving in a fixed ring of malleable cast iron, about 2¼ in. long and 2 in. in diameter. On opposite sides of this ring, poles are formed, as shown in the accompanying view, about 1 in. wide, and extended at each end to afford a means of attaching the end plates of the machine, which carry the bearings, binding screws, &c. With the exception of the poles the ring is covered with two coils of coarse wire, both coils being connected with each other, and also with the battery that ordinarily serves as the source of power. The battery current is also led to the revolving armature by means of two pairs of small rollers mounted at the ends of light springs attached to one of the circular end plates, the direction of the current being reversed at each revolution of the armature. The pole-pieces of the latter are curved so as to be concentric with the enclosing ring, and of such dimensions that they are in very close proximity to the inner surface of the coils around the ring.

"As the revolving armature constitutes an electro-magnet induced currents are developed, which on account of the arrangement of the commutator are always of that in

nature for one half of the ring, and of the opposite nature for the other side of the ring, that is to say, each pole of the revolving armature is alternately north and south, during each revolution, being changed by the action of the commutator, as the armature passes the opposite poles of the enclosing ring. The coils around the fixed ring are wound in opposite directions, so that the currents induced by the

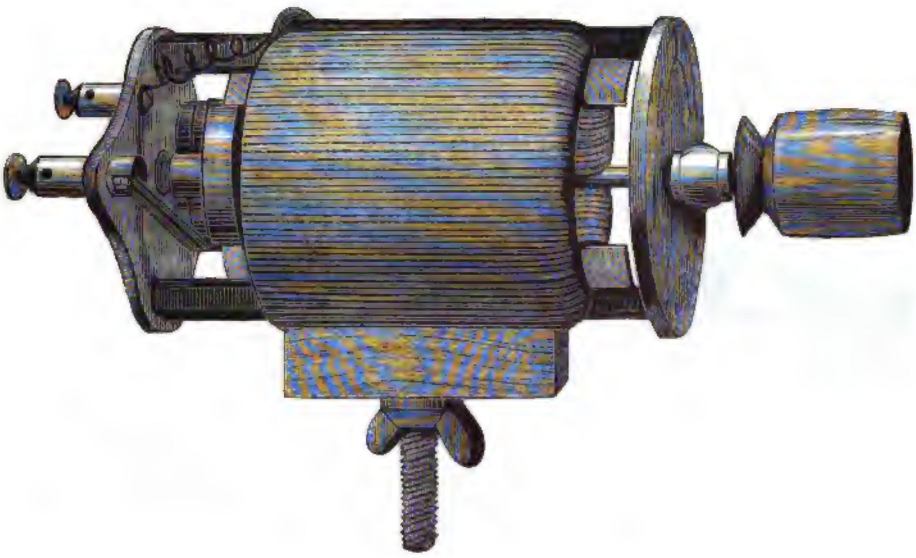


Fig. 1.

opposite poles of the armature at the same time, are of the same nature, and instead of neutralising each other contribute to the efficiency and power of the motor, while their direction is always the same as that from the battery which electro-magnetises the fixed armature. From this description it will be seen that the principle of the machine is to

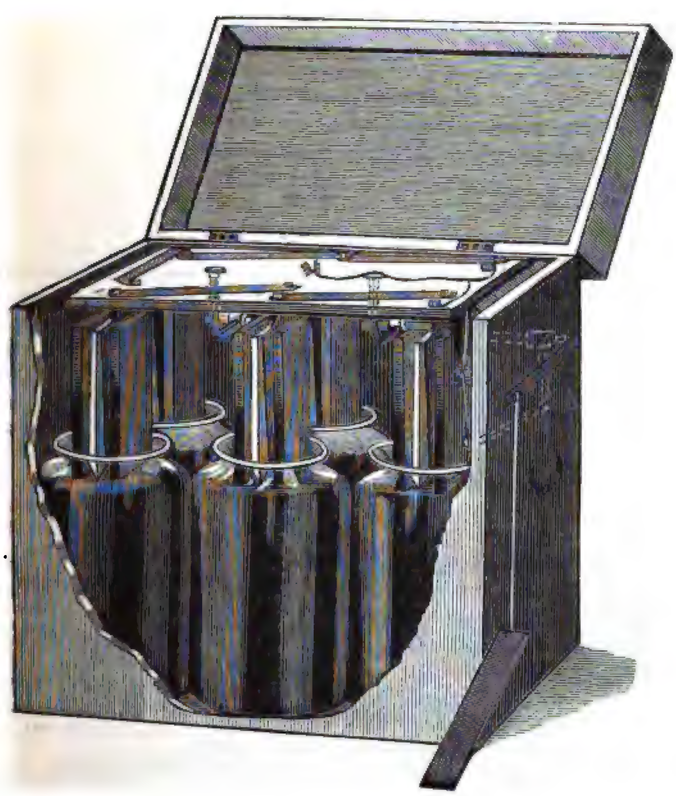


Fig. 2.

utilise the induction currents from the revolving armature, and to add them as supplementary and useful currents to that passing from the battery to the coil on the ring." It is further stated that "this utilisation of the induced current, which in other motors has been a fatal disadvantage, is a feature which greatly increases the facility of working, and enables, with very light weight and in small space, to have a really very powerful engine." The smallest motors made by the manufacturers of the Griscom motor are only $2\frac{1}{2}$ lbs. weight, but are said to be capable, with a suitable current, of doing work equivalent to 1 man-power.

The motor may be driven by a battery, or several motors may be driven by a dynamo-electric machine, or by accumulators. One bichromate battery of six cells is sufficient to drive such a motor as we have described at a speed of 5,000 revolutions a minute, the power developed being sufficient to work a small lathe or a sewing machine at a very rapid rate. The intensity of the current, and therefore the speed of the motor, can be regulated by immersing the couples of the battery more or less deeply in the solution, which is done by means of a pedal placed conveniently to the foot of the operator. It is stated that a single charge of the battery is

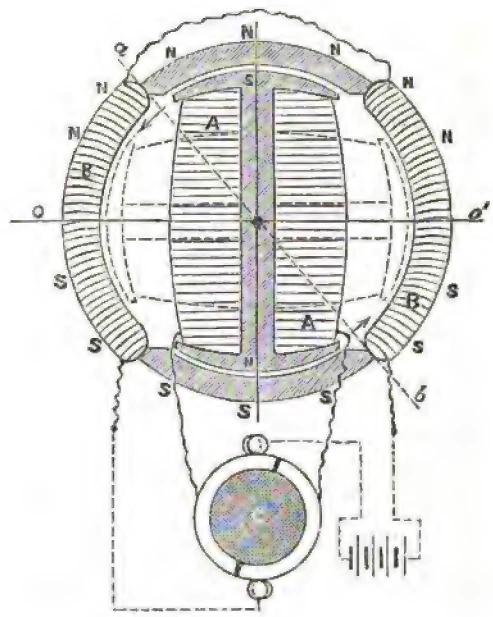


Fig. 3.

sufficient to produce 1,000 yards of average stitches in a sewing machine.

These motors may be made of any size, the power of course rising in proportion. There is no limit to the applications of electro-motors, which range from sewing machines to tram-cars, and from rotary fans to rock-drilling. A factory fitted up with a steam-engine and dynamo can, without any shafting, have a separate and independent motor driving each tool, its power being proportioned to the tool. The cost is said to be very trifling, being estimated at one penny per hour per horse-power. The simplicity of the

motors makes them very cheap to manufacture, and amongst their merits that of extreme cheapness must not be omitted. When used independently for sewing-machines, dental lathes, &c., the battery used (fig. 2) is an improvement on the ordinary bichromate battery. This is so arranged that the plates are lifted clear of the liquid by a spring, and allowed to drain. This avoids the usual expense of having the battery re-charged frequently. By this means the battery not wasting when not at work, it will last for a considerable time with a single charge. The speed and power can be also regulated by dipping the plates more or less in the liquid. This battery is enclosed in a tight box, which may be used as a seat by the operator.

By referring to the diagrammatic sketch of this apparatus (fig. 3) we think that we can make it evident that Mr. Griscom is mistaken in his idea that the induced current assists him in any way. As the connections stand the magnetism of the armature, A, is changed every half revolution. The change does not take place until the centre line of the armature has arrived at *a*, *b*; as the commutator, C, has the position shown in the diagram when the armature poles are *directly opposite* the poles of the ring, B. We will assume that the change has occurred, and that the armature is in the position of the dotted line, *a*, *b*, travelling in the direction of the arrows. Each half of the ring is magnetised oppositely, as shown by the letters N, N, N; S, S, S; and the neutral point is at O, O′. It is very well known that if a battery and galvanometer be connected in circuit with an electro-magnet, then if by any means the magnetism is suddenly weakened the current then set up is found to be in the same direction as the battery current, as indicated by a momentary increased deflection of the needle. If, on the other hand, any increase in the magnetism be rapidly effected, the extra current is then opposed to the main current of the battery.

If the Griscom motor is considered from this point of view the inventor has not apparently overcome the difficulty common to other motors, as he believes. When the S pole of the armature is *approaching* the N of the ring, the magnetism is increasing; and when it is just *leaving* the same pole, it is suddenly changed to N; and is then approaching the S pole of the ring, the magnetism again increasing. Of course the same remarks apply to both poles of the armature. It must be clear, therefore, that the induced current is in an opposite direction to the current of the battery.

Indeed, it is hardly credible that Mr. Griscom could expect to get more current than is produced direct from his battery, or stated in another way, that his motor should give out *proportionately* more energy than is communicated to it, which is the equivalent of Mr. Griscom's reasoning. However, these facts do not detract from the simplicity and usefulness of the apparatus he has devised.

The double roller contacts in the motor we have described are certainly advantageous in reducing friction and wear, and as one is in advance of the other, the sparking at the commutator is reduced to a minimum. We should, however, be inclined to think that they are used at the expense of a good connection, and the probability therefore is that the available current would be somewhat reduced.

The second electro-motor shown, fig. 4, has been designed by Mr. Chaster, whose telephone we illustrated and described last month. The illustration itself is an almost sufficient explanation. The apparatus has six terminals, and the connections may be so arranged as to make it act as a generator with the field-magnets forming a shunt circuit; or as a motor, when armature, electro-magnets, and battery, are all in one circuit, as shown in the "Griscom" diagram. It is exceedingly well made, is free of patents, and we believe Mr. Chaster has supplied either directly or indirectly a considerable number of the motors. The field-magnets are of a different form to those adopted in the "Griscom" system, and slit-springs are employed for commutator rubbers, instead of rollers. We have no actual information concerning the efficiency of Mr. Chaster's motor, but we understand that the smallest size has been usefully employed to operate the overhead motion of a small lathe.

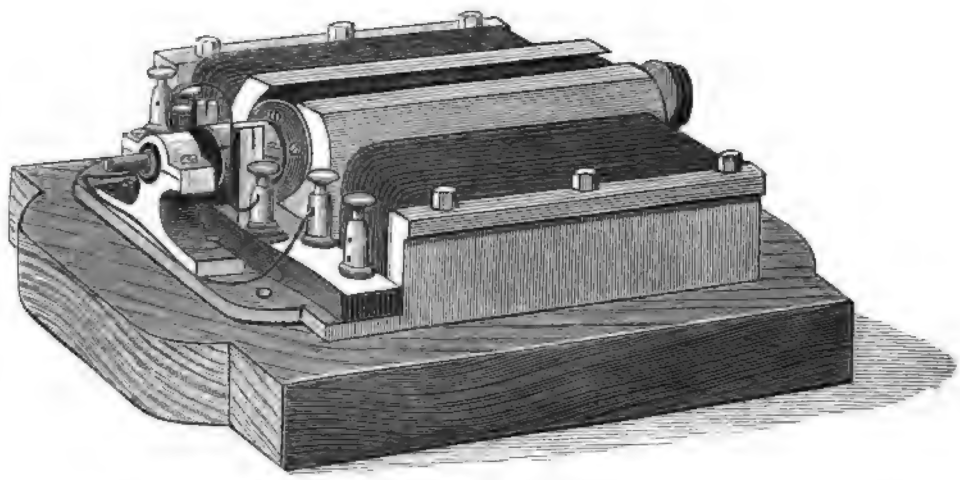


FIG. 4.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

MANGANESE.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In reference to the letter of "An Old Subscriber" in your issue of the 9th inst., page 205, I have had upwards of a quarter of a century's experience in manganese as a speciality and can give your correspondent every required information, which I shall have pleasure in doing, if you will put him in direct communication with me; for to go thoroughly into details would probably occupy more space than your valuable Journal can afford.

In the meantime, if "An Old Subscriber" will give me a sampling and inspecting order for the 50 tons trial shipment to London alluded to, I will be able to advise him reliably *re* the value and disposal of this and further shipments of the mineral.

I am, dear Sirs, yours faithfully,

GEO. G. BLACK[illegible]WELL,

Manganese Merchant and [illegible] Mineral Broker.

Liverpool, *September* 15*th*, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—"An Old Subscriber" requires some information respecting manganese, and I tender a few notes on the subject.

With a view of securing the best results from manganese in Leclanché batteries, I obtained various samples and tried them made up, and submitted them to working tests.

Those containing oxide of iron are useless, they cover the cells with the oxide and have a detrimental effect on the zincs. The dead black kind gives very poor results; some kinds which are well crystallised, of a rather bluish tint, give good results at first but are not permanent, I believe owing to its hardness. The kind I find best is crystallised, not very hard, nearly black. When rubbed between finger and thumb it leaves a bluish shining mark like black lead.

W. GROVES.

89, Bolsover Street, London, W.
September 14th, 1882.

THE GÜLCHER ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—We observe that you have in your issue of to-day a notice of the electric lights at the North East Coast Exhibition at Tynemouth. And we regret to observe that although we have had accounts from our agent in Sunderland to the effect stated in the extracts herewith sent you, that you should not have noticed the installation at all.

Yours truly,
ALFRED THOMPSON.
General Agent for the Gülcher System.

121, Bishopsgate Street Within,
London, E.C., *September 16th*, 1882.

[We refer our correspondent to our "Notes" columns.—EDS. ELEC. REV.]

ELECTRICAL INVENTION.

[We have received a letter from a friend from which we publish the following extract, which will doubtless prove interesting to all our readers.]

"You lately inserted a paragraph about the resistance of carbon. The observation that carbon becomes a better conductor when heated is a very old one, and is originally due neither to Mr. S. A. Varley nor to Mr. Shelford Bidwell. Prof. Matthiessen in 1858 (*Pogg. Ann.*, Vol. CIII., p. 432), pointed out the fact as regards graphite and wood charcoal. Beetz in 1860 (*Pogg. Ann.*, Vol. CXI., p. 619), discussed the phenomenon of carbon and some other substances becoming better conductors when heated, and gave an instance also in which a peculiarly fine grained (Paris) gas coke behaved exactly like a metal, whilst other samples of coke less fine grained behaved the other way. At that date the phenomenon was no novelty. What a pity it is that people cannot be saved the trouble of re-inventing and rediscovering old things.

"With regard to Mr. Lowdon's letters to you, that which appeared in your previous No. is quite correct. I remember reading an account of the experiment of telegraphing without wires, by means of immersed plates in a river, twenty years ago. I think you will find that it is the subject of at least one patent. This world must be coming to an end shortly, we seem to have tumbled upon a sort of universal resurrection of dead and gone electrical facts."

IMPROVEMENTS IN ACCUMULATORS.

WE have no intention of prolonging the discussion with M. Blanchart; indeed, it has already lasted too long. We criticised his method of calculation, and our opinion remains unaltered, notwithstanding the long reply of our esteemed correspondent. The figures 23,600 kilogrammetres per kilogramme of active material is at once surprising and fanciful, and, if we may be allowed to use a somewhat familiar expression, it serves to *épater les bourgeois*; and we might designate M. Blanchart's method—The art of manipulating kilogrammes of minium so as to obtain fanciful—we repeat the term—results in kilogrammetres. There is, however, another step to be taken in this direction. We beg to be allowed, in conclusion, to point it out to M. Blanchart. Certain writers give 2·60 as the electromotive force of the secondary couple of plates of lead; let us accept this figure, which will be almost as accurate as admitting a constant electromotive force of 2·15 volts. We know, besides, from the electro chemical equivalents that a gramme of lead corresponds to 928 coulombs. The work developed by the chemical action, *i.e.*, the oxidising of a gramme of lead, corresponds, therefore, to:

$$\frac{928 \times 2{\cdot}6}{9{\cdot}81} = 246 \text{ kilogrammetres,}$$

according to the laws of Joule and Faraday.

Reckoning, thus, 242,000 kilogrammetres per kilogramme of lead, and as we can also take into account the fact that the oxidising of a gramme of lead on one of the plates corresponds to the reduction of another gramme on the second plate, this result must be diminished by one half, and thus we can only reasonably expect to obtain 123,000 kilogrammetres per kilogramme of active material, according to M. Blanchart. Only we here find ourselves at the limit of acceptable hypotheses, and even of those that cannot be accepted; beyond this we have only to draw on our imagination. There is a French proverb to the effect that *quand on prend du galon, on n'en saurait trop prendre*. When we lay down hypotheses we cannot make too many, and this is what justifies the above figures, and which are still more fanciful than those of our courteous correspondent.

The moral of all this may be briefly expressed as follows: *The acceptation of a fact or a result should not rest on any mere hypothesis.* This is the origin, and the real cause, of our discussion with M. Blanchart. The public will judge between us.—[EDS. ELEC. REV.]

THE TELEPHONE.—We have received another letter on this matter from "Injustice," in which he says: "Your correspondent who signs himself as 'Justice' admits that he himself invented and put into quotation-marks, as a quotation from Mr. Justice Fry's judgment in a recent telephone suit, words which are not to be found therein; and he now defends this literary fraud!" The remainder of our correspondent's remarks we do not deem it necessary to publish, and we therefore trust that further correspondence on the subject may not be re-opened.—[EDS. ELEC. REV.]

D.S.—We do not think you can obtain the first edition of the book you refer to, unless you come across it at a bookstall.—[EDS. ELEC. REV.]

FAREHAM.—The matter you refer to has already been touched upon in Mr. Lowdon's letters to us.—[EDS. ELEC. REV.]

ON A NEW PROCESS FOR THE INSULATION OF ELECTRIC WIRES.—By M. H. Geoffroy.—Public attention having been much excited by various accidents due to the imperfect insulation of electric wires, I take the liberty of submitting to the Academy a new process, which seems to me to suppress radically all danger of fire, even when the wires are in contact with combustibles.

This process consists in covering the conductor wires with a packing of asbestos, and then placing them in a lead tube in the ordinary manner.

From experiments performed at Paris by M. H. Lippmann, engineer to the Faure Electric Accumulator Company, and which I am about to repeat, it results that a wire, like the sample accompanying this memoir, may be entirely dissipated without the spark being communicated outside. Though the experiment was performed with a powerful current on a short length of wire, where all the heat was, so to speak, condensed, the lead showed no trace of incipient fusion. The volatilisation is the affair of the tenth part of a second. The lead cannot melt, because as soon as the copper is burnt the current is interrupted.

Another experiment, very easily made, proves that the electric insulation is very satisfactory, and that no portion of the current is conducted away by the intervention of the asbestos.—*Comptes Rendus*.

[We have already briefly alluded to this in a former number of the ELECTRICAL REVIEW.]

OBITUARY.

GEORGES LECLANCHÉ.

ON the 14th of September, 1882, at 7 p.m., Georges Leclanché died at Paris, at the age of 43 years, a man universally well known and esteemed, the inventor of the peroxide of manganese battery. After leaving the Ecole Centrale des Arts et Manufactures de Paris, in 1860, Leclanché entered, as chemical engineer, the laboratory of the Compagnie des Chemins de Fer de l'Est, where he remained until 1867.

The year 1867 was the time of his first patent for peroxide of manganese batteries with a porous cell. He left the Compagnie to devote himself almost entirely to the industrial development of his idea, which he completed by a series of subsequent patents. Two of these new patents are especially important: that of 1873, relative to cylindrical agglomerate surrounding the carbon, and that of 1876, relative to movable agglomerate plates maintained against the carbon by india-rubber bands. Very limited at its commencement, the manufacture of Leclanché batteries is now almost monopolised at Paris by M. Barbier, employing 50 workmen, who manufacture at least 2,000 plates per day, and have turned out during the year 1881 about 280,000 elements.

At the present day complete elements or simply agglomerated plates manufactured at Paris are exported to all parts of the world. Leclanché batteries have penetrated everywhere; the recent invention of the telephone has given them a fresh impetus, and opened up an immense trade, of which the importance can scarcely at present be predicted; their increasing employment for domestic purposes, bells, calls, electric lamp-lighters, telephones, &c., has familiarised the public with electricity, and, to some extent, made way for more important applications. The capital invention of M. Leclanché will have been, therefore, at once a service and a benefit. His premature death in the full maturity of his intellectual power and of his chemical and electrical knowledge will be deeply regretted by all those who are interested in the progress and future of the applications of electricity.

Outside of his researches on batteries, which, to reduce them to a practical form, absorbed a large portion of his time, M. Leclanché was occupied with electric horology, and devised, to distribute the time to recording chronometers, a sure and ingenious system of simple contact, very little known, and applicable to a number of electrical instruments. We give a description of it in our other columns.

NOTES.

DYNAMO-ELECTRIC MACHINES.—We understand that the new machine of Sir William Thomson and Mr. Ferranti consists simply of a wavy or gridiron-shaped ring of copper revolving between two sets of electro-magnets. There is not, of course, any commutator, as in other machines, and the cost of construction is much reduced, as will be easily understood. It is stated that the experimental trials have shown that 12 (20 candle-power) incandescence lamps can be produced per horse-power. We take this in the ordinary acceptation of the term, and not as electrical horse-power developed in the lamps, otherwise the remarkable efficiency of the new machine would not be so manifest. It is further remarked that the Thomson-Ferranti machine is superior to that of "Brush" in the proportion of 12 to 3¼, or in other words, that the power required to produce 12 lamps of 20 candle-power each by the Brush system is, roughly speaking, about four times greater than that necessary to give the same result in the former. The electro-magnets of the new machine are intended to be excited from a separate source.

Mr. Robert Hammond, in writing to the *Times* on this subject, makes a very curious remark. He says: "Comparing a Ferranti machine of a given size and weight with one of any other system of the same size and weight, the new machine would *absorb* (the italics are our own) five times the horse-power and turn it into its equivalent of electric light, and it is therefore five times as efficient." Now, if a given machine absorbs *one horse-power* and gives out its equivalent in electric light—say, for example, 2,000 candles—and a similar machine absorbs *five horse-power* and gives out its equivalent as 10,000 candles, we cannot see the superior efficiency of the one. We may, however, have misunderstood Mr. Hammond's meaning, but he must not forget that there are already machines at work which will give a useful return in the external circuit of 60 per cent. of the engine horse-power expended upon them. One cannot be too careful in writing on scientific matters to journals chiefly read by the general public, who may be so easily misled.

A NEW ELECTRIC LIGHT COMPANY.—There was constituted at Sunderland on Monday last the North Eastern Electric Light and Power Association (Limited), with a capital of £100,000, in 20,000 shares of £5 each. Alderman Storey, M.P., presided at the preliminary meeting.

ELECTRIC LIGHTING.—At the half-yearly meeting of the shareholders of the North British Railway Company, held at Edinburgh last week, Mr. Roughead said he was one of those who advised the directors to try the electric light, and he wished to know the difference in cost between lighting up the Waverley station with the electric light and with gas.

Sir James Falshaw (the chairman), said there were two important stations, one in Edinburgh and one in Glasgow, illuminated by the electric light. The other day, when in Glasgow, he asked the station master if the light answered well, and was told that it was perfect. The electric lighting system in Edinburgh had been extended, and he thought they would find there was scarcely a better lighted station in the kingdom. As regarded the expense, there was little difference between the electric light and gas.

Mr. Roughead thought that when Edinburgh and other places had given up the electric light, it showed it was much more expensive than gas. He was quite satisfied with the light.

The Chairman: The arrangement is a temporary one, but if it proved successful in a year and a half, it might be permanently adopted. No one could find fault with a well-lighted station.

THE Town Council of Crieff at the last meeting decided to favour the introduction of the electric light. An abundant supply of water is available for motive-power.

A LETTER from the Brush Electric Light and Power Company brought this question again under the notice of the Montrose Town Council. These gentlemen are of opinion that it would be a very impolitic thing for them, notwithstanding the decision of Edinburgh and some other places, to refuse their consent to all the electric lighting companies, especially seeing that there would be no expenses to the corporation, who wished to supply the borough with electricity. They therefore intrust to the Lighting Committee the task of finding a company in whose application to the Board of Trade the council may concur.

WHEN the several requests for acquiescence of the local authority in applications about to be made to the Board of Trade came before the Inverness Town Council, that body resolved "that they reserve to themselves all privileges in connection with the lighting of the town, and further that they object to any company interfering with these privileges."

THE Police Commissioners of Helensburgh, having considered applications from two electric lighting companies, appointed a committee to collect information regarding the best mode of supplying the electric light to the burgh and to consider the whole subject.

THE gentleman who brought the application for supplying electricity to Bishop Auckland under the notice of the Local Board said he claimed for it the attention due to an important question, and which, having regard to the conflict between the board and the gas company, was at the present moment urgent. He showed that the town was suffering from the high price of gas, and the rigour with which the lighting power of the company was exercised. A special committee was appointed to investigate and report upon the question.

AFTER full consideration the Dundee Gas Commissioners instructed their clerk to inform the several companies who had preferred requests for permission to supply the towns with electricity, that the gas commissioners contemplated applying in next session of Parliament for a provisional order to secure the same object; and that they could be no parties to the companies obtaining the permission they sought.

THE deliverance of the civic powers of Scarborough is, "that it is undesirable, at present, to give consent to any application for a licence under the Electric Light Act, 1882."

A LETTER from the Hammond Electric Light Company has got as far north as Thurso (apparently before the Electric Lighting Act), for at the last meeting of the Town Council they instructed their clerk to get a copy, and meanwhile to ask the company what they would undertake to light the town for during the present season.

THE Arbroath Town Council have refused their consent to the applications of the Hammond, Brush, and Swan Companies, "because the electric light is still in its infancy, and it is difficult to say what the system might come to."

A SPECIAL meeting of the Dundee Gas Commissioners was called for Wednesday last, "for the purpose of resolving to apply to the Board of Trade, under the Electric Lighting Act, 1882, for a provisional order to authorise the commissioners to supply electricity for public and private purposes, as defined by the said act, or for some of those purposes, within the burgh of Dundee, or some part therein."

THE ELECTRIC LIGHT IN SPAIN.—The Anglo-Spanish Brush Electric Light and Power Company is making good progress in the Peninsula. The towns of San Sebastian and Irun are already lighted by their local authorities under contract with the Anglo-Spanish Brush Company, and so pleased are the authorities with the result that they have increased the number of lights very considerably. In England the electric lighting companies have to compete with gas at a cost of from 2s. to 5s. per 1,000 feet, while in Spain the price is from 12s. to 15s. per 1,000 feet. As many towns in Spain have no gas in consequence of the expense of erecting works and the cost of gas when produced, it is reasonable to suppose that ere long these towns will adopt the electric light when it can be supplied at moderate rates. It is said that a scheme for lighting the port and harbour of Bilbao, Spain, is now awaiting the sanction of the authorities. It provides for the establishment of 40 lights, each of 2,000 candle-power, supplied by two engines, and the work of construction is calculated to cost about 15,000 dollars, while the annual cost of maintenance is not expected to exceed £2,000.

KILLED BY ELECTRICITY.—A Reuter's telegram from Trieste, dated September 15, says:—"The hurricane which destroyed the nave of the pavilion of the exhibition also damaged the electric light apparatus. A man while engaged last night in repairing it accidentally received the full discharge of the current and was killed on the spot."

ELECTRIC LIGHT AMALGAMATION.—The *Financier* says: —There has been considerable inquiry, on American account, for Swan electric light shares, upon the strength of pending negotiations between that company and the Edison Electric Light Company for amalgamation, whereby they will virtually control the business of incandescent lighting. Accordingly, the shares of the Swan Electric Light Company, which are of £5 with £2 paid, possessing a capital of £1,000,000, issued this year, have advanced from ⅛ to ¼ prem. As indicating the possibilities which exist in connection with the electric light market, it should be added that transactions have taken place in London in the £5 paid shares of the Edison Company (the capital of which has been privately placed in strong hands) at £15.

ELECTRIC LIGHT IN NEW ZEALAND.—It is proposed to introduce the electric light at Kaiapoi Wollen Factories; and as it has been found, says the *Christchurch Press*, that the power of the Company's engine is sufficient to drive a dynamo machine capable of furnishing the illuminating power for all the town lamps, it is thought highly probable that the municipal authorities may arrange with the company for the improved lighting of the borough in this way.

THE ELECTRIC LIGHT AT CLEETHORPES, LINCOLNSHIRE.—On Friday, the 15th inst., the Brush Midland Electric Light and Power Company, Limited, commenced their first instalment towards the lighting of Cleethorpes by the electric light. The place is to be illuminated partly by arc lights, and partly with Lane-Fox incandescent lamps. The arc lights were first used, and they have been continued each evening since, burning brilliantly and steadily. Numbers of persons from New Clee and Great Grimsby have been over to see the light and seem much delighted thereat.

The incandescent lamps will shortly be fixed, when we hope to give a description of the work, which is being carried out under the superintendence of Mr. S. Vyle, the company's electrician.

ELECTRIC LIGHT IN DUNDEE.—The directors of the Kinnaivel and Argyll Halls, Dundee, have accepted the offer of the Northern Electric Light and Power Company, to light their halls by electricity, the work to be done as soon as possible.

THE EDISON ELECTRIC LIGHT.—A decided improvement in the lighting of the Holborn Viaduct is now to be seen. The double lamps have been discarded for single ones of greatly increased brilliancy, and the general effect is very marked. This change will, however, probably necessitate more frequent renewals, now that the carbon filaments are worked to a higher candle-power.

THE GÜLCHER ELECTRIC LIGHT.—This system of electric lighting is attracting considerable attention at the Tynemouth Exhibition. We notice in the Shields *Daily Gazette*, that Swan's light was rather deficient, but the Gülcher, which is placed in the lower machinery shed and neighbouring sections, was a great success. *It was the finest display seen since the opening of the Exhibition.* The Hammond light was not, somehow, so good as it has been.

We also clip extracts from letters of Mr. Thompson's (see "Correspondence") Sunderland agent, to the following effect:—"The Gülcher light is the coming light, to my mind. It was amusing the other evening when we started; the place was all lit up by the other lights, and appeared as bright as day. We had only one of our lamps in this large section. We started, and the change was both literally and figuratively electrical. It was as though a great big sun had dropped in amongst us. The rest were immediately dwarfed into moon and stars, beginning with the Hammond Company as the moon. There was a rush to our stand, hitherto deserted, and the Gülcher lights are attracting no end of attention.

"Your lights are simply perfection—the others, even the great Hammond, are not in it. I feel quite proud of them. Up here they have dwarfed all the rest."

If the future of this system depended on the enthusiasm of its Tynemouth advocates its success would be certain, but when one arc lamp gives out a superior light to others the chances are that it is consuming proportionately more horse-power. However, we wish the Gülcher light may be met with the favour which it certainly deserves.

NEW CABLES.—It is rumoured that the Telegraph Construction and Maintenance Company has in course of manufacture a duplicate cable for Lisbon-Madeira, and a triplicate to be laid from Suez to Aden. We also hear that the company's s.s. *Kangaroo* is now off the works at Greenwich, shipping cable to connect Malta and Tripolis, and that she sails this week. News from Portugal informs us that a contract has been signed between the government and Mr. Braam for the laying down of a cable between Lisbon and the United States, touching at the Azores.

ANGLO-AMERICAN TELEGRAPH COMPANY'S CABLES.—We are informed that the Telegraph Construction and Maintenance Company's s.s. *Scotia* has succeeded in picking up the Anglo-American Telegraph Company's cable laid in 1869 between Brest and St. Pierre in mid-ocean, in depths varying

from 1,600 to 1,930 fathoms of water, and repairing the fault which occurred on the 18th March last. A minor fault has also been repaired at a distance of 335 miles from Brest, in a depth of 1,269 fathoms. The whole of the company's system of cables and land lines is now in perfect working order and condition.

TELEGRAMS FROM THE SEAT OF WAR.—The Eastern Telegraph Company notify that telegrams are being received at present from Cairo very irregularly, several days' messages having accumulated and apparently got out of order, causing delay in some cases of three and four days. The Egyptian Government announce that they are ready to transmit international telegrams to all stations in Egypt, but, in face of the irregularities referred to, the Eastern Company will accept messages at senders' risk only. The Eastern Company's own wires to Cairo and Suez are being rapidly restored.

THE STEAMSHIP "INTERNATIONAL." — The s.s. *International*, Captain W. F. Wardroper, left the Silvertown Telegraph Works for Greenhithe, on Wednesday evening, the 20th inst., and after having adjusted her compasses, she sailed from there for Soussa, Tunis, on Thursday afternoon, the 21st inst. The *International* carries some 300 nautical miles of cable, to be laid for the French Government along the coast of Tunis, from Soussa to Sphax, Sphax to Gabes, and from Gabes to the island of Djerba. Mr. Theophilus Smith is in charge of the expedition, and is assisted by Messrs. H. Benest, J. Rymer-Jones, J. W. A. Knox and others. The French Government is represented on board by Messrs. Rambaud and Schaeffer, Engineers in the French Telegraph Administration, and who superintended at the Silvertown works the making, testing, and shipping of the cables. On arrival at Soussa, Messrs. Durregne and de Nerville, of the French Telegraph Administration, will join the ship to witness the laying operations. At the special request of the French Minister of Posts and Telegraphs, Mr. Borel, son of the Directeur du Bureau International des Postes de Berne, accompanies the expedition.

CABLES AND CORAL FISHERS.—*L'Electricité* of the 16th inst. contains the following :—"One of the two English cables used for the Indo-China traffic, landing at the town of Bona, in Algiers, was cut on Tuesday last some twenty-two miles from shore. Coral fishers are most probably the cause of this accident. At the time that the cable broke the Bona office was receiving a message. Thanks to an apparatus of recent invention it is possible to calculate exactly where the place of the break is located. The cable will be picked up and repaired. Unfortunately, the two telegraph ships belonging to the Eastern Telegraph Company fitted out for this kind of work are at the present moment employed in laying a cable at Alexandria. The repairs of the Indo-China cable will, therefore, suffer some delay."

We know that the French Telegraph Administration in Algiers have had great trouble with the coral fishers at Bona, as they frequently fouled and damaged the French coast cables whilst fishing for coral off that port. The commandant of the harbour had them all called together to a meeting, and there told them that the most severe measures would be taken against them should they continue to interfere with the cables, as he was quite prepared to indemnify them for any losses they might suffer through fouling the cables.

CHINESE TELEGRAPHS.—We read in *Nature* of the 14th inst. the following :—We have received a letter from a gentleman in Hong-Kong, signing himself "Verax," referring to a note in our issue of June 1st (*see* ELECTRICAL REVIEW of June 10th) on the subject of the projected Chinese telegraph line between Hong-Kong and Canton, and the alleged refusal of the colonial authorities to permit the landing of the cable across Victoria Harbour on British territory. The facts as stated in our note he allows to be correct. But whatever the grounds—and "Verax" fails to show there are any substantial ones—for local opposition to the enterprise, we regard it as peculiarly unfortunate that any forward step of the Chinese should be retarded by the British authorities.

THE TELEPHONE CONVENTION IN BOSTON (AMERICA).—At the meeting of September the 6th, Mr. T. D. Lockwood, of the Committee on Cables and Subterranean Telegraphy, read a paper giving the results of experiments made with underground wires since the invention of telegraphy, and the disadvantages arising from that method of laying wires.

William F. Jackson, of Detroit, Mich., from the Committee on Telephonic Supplies, described at some length the different appliances used in telephony, but refrained from expressing an opinion as to their merits.

W. D. Sargeant, of Brooklyn, from the Committee on Electrical Disturbances, read a comprehensive paper treating of three subjects—leakage, induction, and earth and atmospheric currents—saying that the increasing number and length of wires prove the value of good insulation and conductivity. No loose or unsoldered joints should be tolerated on a telephone line. The great enemies to long lines are induction and retardation. The latter appears to be the most difficult to remove. In so-called anti-induction cables retardation is most manifest. When inductive shields entirely enclose the insulated conductor the metallic circuit appears to remove much of this trouble. A cable, the longest in this country, has been recently laid from Newark, N. J., to Jersey City, some ten miles. The conductors in this cable change their relative positions at every joint of about 1,000 feet, and the remedy seems to be effectual, conversation on a single grounded circuit being carried on without interference with others, and the sound of several Morse wires working from batteries and dynamos was scarcely audible. As to earth and atmospheric currents, it is believed that with well-insulated lines of non-magnetic material a degree of perfection may be attainable that will leave but little to be desired.

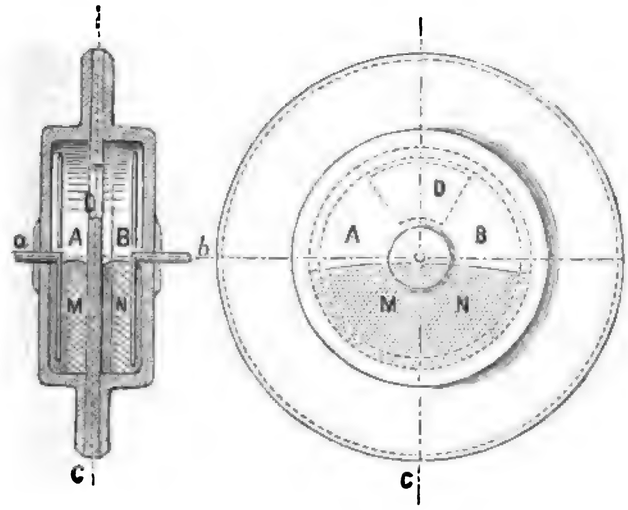
COVERED ELECTRICAL CONDUCTORS.—Apparently the wire-covering business is just now in a thriving condition. The Lea Telegraph Works, Hackney-Wick, the new factory of the well-known firm of Messrs. Phillips Brothers, is just completed, and the engine and shafting are being erected. The building will be lighted partly with arc lamps of the firm's own design, and partly with Edison incandescence lamps. At their old works, in Macintosh Lane, Homerton, an addition of 60 Edison lamps is to be made to the present installation, which we noticed some time since.

LIGHTNING CONDUCTORS.—A copy of rules for the erection of lightning conductors, based upon the recently published report of the Lightning Rod Conference has, with an explanatory circular, been issued by the Explosives Department of the Home Office, to the occupiers of all factories and magazines for explosives, and to those local and police authorities upon whom devolve the inspection of explosives. The rules deal with the material of the rods, their joints, curvature, fixing, &c., and the importance of periodical examination and testing.

PERSONAL.—Captain Shaw, chief of the London Fire Brigade, arrived in Montreal on the 31st August, where he was met by Alderman Hood, Chairman of the Fire Committee, and taken to the Windsor Hotel. In company with Alderman Hood he drove to the City Hall, and visited the central fire alarm telegraph station on the top of the building, where the system of alarms and the connection of the different stations on each circuit were fully explained to the visitors. Captain Shaw expressed himself as very much pleased with the system and apparatus.

ELECTRICAL ENGINEERING.—We beg to draw the attention of our readers to the following notice: Prof. W. Grylls Adams, F.R.S., will deliver a course of lectures on electricity at King's College, London, during the ensuing session. A course of practical work in electrical testing and measurement, with especial reference to electrical engineering, will also be carried on under his direction in the Wheatstone Laboratory. The lectures will be given once a week, on Thursday at 2 p.m., and the laboratory will be open daily (Saturday excepted) from 1 to 4. Fee, including both lectures and laboratory work, £8 8s. for one term, or £21 for three terms. The work will begin on Monday, October 9th, 1882. Further particulars may be obtained on direct application to Prof. Adams.

M. G. LECLANCHÉ'S MERCURIAL CONTACT.—When it is desired to impart the exact hour given by a standard clock to a series of receivers, the difficulty exists not in the receivers themselves, but in the establishment of electrical contacts perfectly good, equal in duration, without appreciable resistance, and rigorously equi-distant. If one contact lags, the repeating dial loses; if, on the contrary, the reverse takes place, the repeating dial gains. In order to obtain a good contact it is necessary to produce a metallic contact without oxidation, and without possible consumption of the metals. M. Leclanché solved the problem, first, by producing contact by the mixture of two liquid metals, in a hermetically closed vessel, and in the presence of an inoxidisable liquid or gas, thus protecting the metals destined to form the contact from atmospheric air; second, in only utilising from the standard clock the power required to operate a simple escapement, and in taking from a special source the power necessary for actuating the contact. The



apparatus represented above, of the natural size, is made up of a glass vessel divided into two chambers, A and B, by a vertical glass partition, C, perforated at the upper part by a hole, D. The chambers, A and B, are half filled with mercury, and also with a small quantity of protecting gas or liquid. The barrel is then hermetically sealed. By means of the tubes, *a*, *b*, the mercury in the two chambers can be put into communication, the circuit being completed by means of two platinum wires arranged in a circle in the interior of each chamber in such a way as to always keep in contact with the mercury during the rotation of the barrel.

By virtue of this arrangement, the barrel cannot complete a revolution without the aperture, D, becoming immersed in the mercury, and the two metallic pieces, which are ordinarily insulated by the partition, C, form a perfect electric contact between the two portions of mercury, M and N. When the revolution is completed, and the partition, C, again separates the mass of mercury into two parts, electrically insulated, a spark is indeed produced, but as it is produced in a closed vessel, and in a protecting medium, and consequently does not come in contact with the air, there can be no alteration of the metal; the spark produces a slight volatilisation of the mercury, which condenses in a pure state, to be again mixed with the principal mass, which is thus preserved indefinitely without any alteration. In practice, two openings, D, are arranged diametrically opposite, and producing a contact for each half revolution of the vessel..

The rotation of the barrel is obtained by an independent auxiliary spring; the standard clock has only to furnish the power necessary to actuate the escapements, each of which causes a rotary motion, and consequently the contact which results from it. This arrangement of mercury contact has furnished, in the hands of M. Leclanché, and his manufacturer, M. Barbier, an entirely regular progression of the receiving dials, absolutely corresponding to that of the standard clock, without gain or loss; a single standard clock allows of the regulation of an indefinite number of receivers. This system of contact is applicable to every description of apparatus founded upon successive electric contacts, repeated at regular or irregular intervals. The great certainty of its action induced us to give a description of it to our readers.

A STATUE TO ANTOINE CÉSAR BECQUEREL.—M. Edmond Becquerel, son of the eminent French *savant*, has informed the Académie des Sciences that the erection of the statue to his father, notified by the general council of the Loriet and the municipal council of Chatillon, the execution of which was intrusted to M. Guillaume, member of the Institute, by the committee appointed to receive the subscriptions, will take place on the 21st inst.

NEW COMPANIES REGISTERED.

DUCHY DUPLEX ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).—Capital £50,000, in £1 shares. Objects: The business of an electric light and power company in all branches. Signatories (with one share each): W. J. Thomas, 81, Mildmay Park, N.; A. Harvey, Summerhill Road, Tottenham; A. Clegg, 13, Whately Road, East Dulwich; T. Williamson, 104, Elmore Street, N.; W. J. Twentyman, 264, Amherst Road, N.; Wm. Reynolds, Norbiton, Surrey; J. R. Rusden, Rye Lane, Peckham. The signatories are to nominate the first three directors, qualification, 100 shares; remuneration, £100 per annum to each director. Registered 13th inst., by E. Smith & Co., Abchurch Chambers, Abchurch Yard, E.C.

FERRANTI, THOMPSON, AND INCE (LIMITED).—Capital £240,000, in £5 shares. Office, 110, Cannon Street. Objects: To carry on business as electricians, and to purchase and work patents relating to electricity. Signatories (with one share each): * S. Z. de Ferranti, 24, Richmond Gardens; * A. Thompson, 8, Guildford Place, W.C.; * Francis Ince, St. Benet Chambers, Fenchurch Street; F. A. Holman, St. Benet Chambers; * J. W. Temple, 34, Leadenhall Street; R. Acock, Croydon; Robt. Hammond, 110, Cannon Street. Directing qualfication, 200 shares; remuneration, £1,000 per annum, and one-tenth of all profits available for distribution above the first £10 per cent. Registered 15th inst., by Ingledew, Ince & Co., St. Benet Chambers, Fenchurch Street.

LANCASHIRE MAXIM-WESTON ELECTRIC COMPANY (LIMITED).—Capital £100,000, in £1 shares. Objects: To light thoroughfares, streets, mines, ships, &c., in Lancashire, Cheshire, and North Wales with the electric light, and for such purposes to carry out an agreement of 16th inst. made with the Maxim-Weston Electric Company (Limited). Signatories (with one share each): J. T. Campbell and H. E. Hooper, 17, Warwick Street; H. Watt, J. B. Cox, F. Gerrard, and E. Gribble, 93, Leadenhall Street; C. J. Lewis, 5, Sugar Loaf Court, E.C. The directors are the Right-Hon. Earl De La Warr, Admiral Sir E. A. Inglefield, Messrs. John Roberts, M.P., Hugh Watts, and Thomas Whitworth. Directing qualification, 250 shares; remuneration, £1,000 per annum. Registered 19th inst., by Campbell, Reeves & Hooper, 17, Warwick Street, Regent Street.

* Signatories denoted by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRIC LIGHT COMPANIES.

THE following returns have been recently filed:

FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).—The return of this company was filed on the 14th June, and is made up to 6th June. The nominal capital is £1,000,000, divided into 80,000 shares of £10 each, and 200,000 shares of £1 each. 27,628 of the £10 shares have been taken up, and £2 per share called up, and 50,000 of the £1 shares have been taken up and the full amount called thereupon. The total amount of calls paid is £105,236, leaving £20 unpaid.

EASTBOURNE ELECTRIC LIGHT COMPANY (LIMITED).—The return was filed on 28th June, and is made up to 27th June. The nominal capital is £50,000, in £10 shares. The number of shares allotted is 440, and £5 has been called up on each. The total amount of calls paid is £1,132 10s., and unpaid, £1,067 10s.

ELECTRIC LIGHTING CONTRACT AND MAINTENANCE COMPANY (LIMITED).—The return of this company was filed on the 14th ult., and is made up to the 7th ult. The nominal capital is £2,003,000, divided into 200,000 A and 300 B shares of £10 each. There have been 19,934 A and 300 B

shares taken up, and upon the former £2 per share has been called, and the latter are considered as fully paid up. The calls paid on the A shares amount to £39,915 5s., and unpaid, £2 15s. £50 has also been paid on 100 shares forfeited.

General Electric Lighting Company (Limited).—The return of this company was filed on 22nd June, and made up to 13th June. The nominal capital is £50,000, in £1 shares, and 2,006 shares have been allotted, but no call has been made.

Brush Electric Light and Power Company of Scotland (Limited).—The return was filed on 7th inst. and is made up to 30th ult. The nominal capital is £300,000 in £5 shares. Upon 22,000 shares taken up £2 10s. has been called up and paid, and 8,000 shares have been issued as fully paid in part payment of concessions.

South Eastern Brush Electric Light and Power Company, Limited.—The return was filed on 1st inst. and made up to 23rd ult. The nominal capital is £100,000, in £5 shares, the whole of which have been taken up. Upon 19,600 shares £1 10s. has been called, and the full amount upon the remaining shares. The total amount of calls paid is £31,300, leaving £100 unpaid.

NEW PATENTS—1882.

4366. "A joint for electrical lamps to be occasionally suspended and removed." W. R. Wynne. Dated September 14.

4367. "Systems of electric lighting." W. Morgan-Brown. (Communicated by F. Schmidt.) Dated September 14.

4376. "Dynamo-electric machines." M. Deprez. Dated September 14.

4390. "Electric lamp holders." J. W. Swan. Dated September 15.

4391. "Plates for secondary batteries." N. C. Cookson. Dated September 15.

4404. "Electric lamps and apparatus for use in connection therewith, and for other purposes." H. H. Lake. (Communicated by S. F. Van Choate.) Dated September 15.

4407. "Galvanic elements." J. H. Johnson. (Communicated by A. Bernstein.) *Complete.*

4412. "Locking points and signals by electricity." S. Brear and A. Hudson. Dated September 16.

4419. "Electric arc lamps." J. Brockie. Dated September 16.

4420. "Gaseliers, chandeliers, and electroliers, also applicable to the raising and lowering of other sliding appliances." M. Merichenski. Dated September 16.

4421. "Telegraphic and telephonic apparatus." A. C. Brown and H. A. C. Saunders. Dated September 16.

4422. "Telephonic telegraphy and apparatus therefor." C. A. McEvoy and J. Mathieson. Dated September 16.

4429. "Incandescent electric lamp globes." J. Crowder. Dated September 18.

4431. "Improvements in secondary voltaic batteries, and in the manufacture of material and plates therefor." A. Watt. Dated September 18.

4434. "Galvanic batteries." S. H. Emmens and S. Mason. Dated September 18.

4446. "Electrical meters." T. J. Handford. (Communicated by T. A. Edison.) Dated September 19.

4450. "Porcelain and other insulators." W. E. Langdon and J. C. and G. Fuller. Dated September 19.

4454. "Transmitters for speaking telephones." W. P. Thompson. (Communicated by G. F. Milliken, J. W. Brown, and H. D. Hyde.) Dated September 19.

4458. "Manufacture of carbon conductors for electric lamps." W. R. Lake. (Communicated by E. Weston.) Dated September 19.

4460. "Batteries for generating electricity." G. G. Skrivanow. Dated September 19.

4461. "Dynamo-electric and magneto-electric machines." J. W. Swan. Dated September 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

540. "Dynamo-electric and electro-dynamic machines." J. D. F. Andrews. Dated February 3. 6d. Relates to the construction and arrangement of dynamo-electric machines whereby mechanical power is converted into electricity, and of electro-dynamic machines by which electricity is converted into mechanical power, and to appliances for collecting and distributing the electricity in such machines, and for governing their motion. The inventor constructs the rotating armature in the following manner. On a length of flexible iron rope are wound transversely a number of coils of insulated wire. The rope so coiled is wound in a number of convolutions around a barrel of wood or other non-magnetic material, thus forming the coiled armature of the machine, which revolves between two opposite magnetic fields each extending over a considerable arc of the circumference. The wires of the several armature coils may be connected to a commutator of any known kind.

677. "Interlocking electric and other signalling apparatus." W. E. Langdon. Dated February 11. 10d. The object of this invention is to provide an improved means of interlocking the electric and outdoor signals governing the traffic of railways and tramways so especially—first—it shall not be possible to place a starting or standard signal governing the departure of a given train or engine in the "all clear" position until the electric signal of such train has been placed in the "all clear" position; second—it shall not be possible to release an electric "line blocked" signal until the train for which the signal was set at "line blocked" has passed out of the section; third—it shall not be possible to release the block signal for, or to give the "all clear" signal to the section out of which the train has passed until it has been signalled forward to the next section in advance, and until the "line blocked" signal for that section has been received.

686. "Telephone call or signalling apparatus." A. M. Clark. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 6d. The object of this invention is to provide a simple and effective call for telephone lines. The invention relates to the class of signalling apparatus employing magneto or induction currents in connection with polarised bell magnets.

687. "Telephone central office systems." A. M. Clark. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 6d. Relates to switch boards for connecting two or more line wires at a central telephonic office and for signalling subscribers or users, and for ascertaining their wishes through the central office telephone. The invention consists in movable spring switch bars combined with movable tranverse rods having cam levers for establishing a connection between two or more of the switch bars, and at the same time removing the switch bars from the ground connection. It also consists in a system of central office combined polarised annunciators and relays for operating local circuits so as to move the transeverse bars carrying cam levers to disengage the cam levers and place the switch board in its normal condition. It also consists in an arrangement of subscriber's switch and circuit whereby the subscriber may send either a positive or negative current over the line and through the polarised annunciator and relay so as to call the attendant at the central office, or operate the local circuit of the central office so as to return the switch board to its normal condition.

688. "Transmitting and repeating sounds by electricity, &c." A. M. Clark. (A communication from abroad by G. M. Hopkins, of Brooklyn, America.) Dated February 11. 8d. Relates to transmitters of the description described in the number of the Review for June 1st, 1880, and consists essentially in a contact surface attached to a vibratory diaphragm or other body capable of vibratory motion, and a floating electrode pressed against the contact surface by a column of liquid.

730. "Apparatus for measuring and registering electric currents." C. A. Faure. Dated February 15. 6d. One of the principal objects of this invention is an instrument for permanently registering the amount of electricity that is passing in a conductor, so as to permit the easy reading off of this quantity after different periods of time as a gas meter is read. The principle upon which the instrument is based is well known, viz., that a conductor conveying a current tends to rotate around a magnet. In carrying the invention into practice the inventor employs a cylindrical electro-magnet mounted vertically within a vessel containing mercury, so that the electro-magnet is surrounded with mercury, a conductor in form like the flier of a spinning machine is pivotted on the top of the magnet core and its arms dip down into the mercury. The current to be measured is caused to circulate into the coils of the magnet and into the moving conductor, so that the moving force is proportional to the square of the current. The resisting medium is the mercury in the cup which for this purpose is made sufficiently deep. Now as the force required to move any object through a liquid is proportional to the square of the speed, it follows the number of rotations of the conductor will be proportional to the current to be measured.

740. "Electric lamps, &c." A. M. Clark. (A communication from abroad, by the firm of Solignac and Company, of Paris.) Dated February 15. 6d. This invention, which is applicable both to electric lighting by the arc and by the imperfect contact system of incandescence, relates to improved means of regulating the feeding up of the carbon or carbons, and consists in making the approximation of the carbons dependent on the fusion or softening of a tube, stick, or other object of glass or other material capable of being fused, softened or consumed by the heat of the arc in such manner as to regulate the carbons in virtue of the relation which exists between the length of the arc and its temperature.

749. "Telephonic exchange systems and apparatus." G. L. Anders. Dated February 16. 8d. Relates to improvements in telephonic exchange systems and apparatus, and has reference to the construction and arrangement of the telephones themselves and their batteries, and the mode of using the same in telephonic exchange systems. According to the invention the inventor combines together a telephonic transmitter of the type hereinafter referred to, a telephonic receiver and a peculiar battery hereinafter described, in a portable case, capable of being held in the hand, the several apparatus, which form together the compound instrument, being arranged

normally in the proper position, relatively to each other, for action, and so that the sound waves shall act both upon the receiver and transmitter during the operation of transmitting, whereby a louder and clearer articulation is obtained. The transmitter employed is one of the type of what is known as Hunnings' transmitter, that is to say, one, the handling of which insures its adjustment. The invention divides the chamber or space for containing the powdered carbon or finely divided conducting material, in a loose and free state, into a series of separate compartments, whereby the tendency to a prejudicial accumulation of the said material in one place, when the apparatus is in use, is obviated. The transmitter may be conveniently constructed by the employment of a washer of felt or other suitable non-conducting material, perforated with, say, three holes; this washer is attached by an insulating ring to a metal plate, secured in the case of the compound instrument, and the holes being filled with the powdered carbon or finely divided conducting material, in a loose and free state, a thin diaphragm, composed wholly or partly of metal, is placed over the same, and secured at its edges to the insulating ring by a metal ring and screws. In front of the diaphragm is the mouth or ear piece of the telephone, and in the rear of the metal plate is an electro-magnetic receiver, whilst behind the latter is the peculiar battery next hereinafter described. The battery consists of a plate of carbon, covered with a salt of mercury, and of a zinc plate, which normally is held out of contact with the mercurial salt by means of a spring, a push button being provided in order to bring the two into contact when the apparatus is required for use. By means of the invention all the working parts are enclosed in a single instrument, which is self contained and portable, and brought within a conveniently small compass, so as to be capable of being held in the hand.

758. "Telegraph instrument." F. J. CHEESBROUGH. (A communication from abroad by W. A. Shaw, of Brooklyn, America.) Dated February 16. 6d. This invention consists of a telegraph instrument composed of stationary magnets, combined with a conductor having a vibrating section that is detached and swings freely in the main circuit and in the field of the magnet without breaking the circuit, and which is combined with a sounding device and operated by the action and reaction of a make and break current through the said vibrating section in the field of the magnets; and the said invention consists also of an electro-magnet combined electrically with the said vibrating conductor, and with a local circuit for the purpose of intensifying and quickening the motion of the sounding device.

761. "Dynamo-electric and magneto-electric machines." C. J. CHUBB. Dated February 16. 2d. This invention has for its object improvements in dynamo-electric and magneto-electric machines. The invention consists in causing the electro or permanent magnets of a dynamo or magneto-electric machine or machine for producing electricity to revolve in an opposite direction to the armature or series of bobbins or coils; the object being to increase the speed at which the coils or bobbins on the armature may pass the magnetic poles. The invention also consists in causing a conducting material connected magnetically with such magnets to revolve in an opposite direction to such armature, bobbins, or coils, or conducting materials as may be electrically connected with such bobbins or coils. (*Provisional only.*)

774. "Protecting wires or cables for conducting electricity." J. C. MEWBURN. (A communication from abroad by A. M. J. Jeune, of Paris.) Dated February 17. 2d. The invention consists in surrounding electric conducting wires and cables, after they have been insulated with ordinary insulating materials, or with "Chatterton" bands or strips, with a braided, plaited, or woven metallic covering. (*Provisional only.*)

821. "Electric telegraphs." C. N. TALBOT. Dated February 20. 6d. In many towns and cities, especially in the suburbs, there are dwellings and small manufactories that do not require messenger or telegraph facilities sufficiently often to make it worth while for each person to have a call box. The same is true in buildings containing offices, and under all such circumstances telegraph and messenger service would be a great convenience. The invention provides one signal box for the use of several persons, families, or business men, the same being located at a convenient place for the use of such parties, and provides means by which the person requiring the service will be indicated at the signal box, so that on the arrival of the messenger at the signal box he will be enabled to know who wants him or what is wanted.

2526. "Dynamo or magneto-electric machines." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, New York.) Dated May 27. 6d. The improvements are more especially applicable to the Gramme type of generator, or other dynamo or magneto-electric machine in which the coils or sections of the armature are connected in what is known as a "closed circuit," and the said invention consists essentially in an improved form of current regulator whereby the force of the current produced by the machine may be increased or decreased as may be required to suit the kind or amount of work which is to be performed by the machine; for instance, in electric lighting the current may be reduced to suit one lamp, or increased to suit any additional number of lights up to the maximum number capable of being maintained by the machine. To this end, the main feature of the invention may be stated to consist in the combination with a Gramme or equivalent form of armature and a movable brush holder, adapted to move the brushes on the commutator to the point of greatest effect towards the minimum position of a manipulating or adjusting device engaged with the brush holder, and with a catch or lock, and provided with fixed definite points of graduation and engagement, whereby the brushes can be set and held at certain indicated and fixed positions corresponding to distinct changes of current, suited for one or more lights without trouble or calculation on the part of the operator.

CITY NOTES.

OLD BROAD STREET.

EDISON'S INDIAN AND COLONIAL ELECTRIC COMPANY (LIMITED).

ON Thursday afternoon the first ordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel, Cannon street, the Marquis of Tweeddale, chairman of the company, presiding.

Mr. J. Forwood Tafe, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you are no doubt aware that this meeting has been convened under a section of the Companies' Act which requires that a public meeting should be held within four months of the formation of the company. There is no report, and, of course, in the early life of the company, there are no accounts to submit, but I am here to give any information which may be desired with regard to the past or future of the company. The company was incorporated on the 13th June, and on the Monday following the applications for shares amounted to 24,482, which were fully allotted. The number was not quite so large as we had anticipated, more especially with regard to the interest that the public had before that time taken in similar enterprises; but we ascribe that falling off to the great attention which at that particular moment was being turned to affairs in the East, which very much disturbed the financial world and occupied the attention of the public in general. The object of the company was to acquire the patents and appliances which were the property of Mr. Edison, and which went to compose what is known as the Edison system of electric lighting. Mr. Edison, as probably every one present was aware, was a gentleman of high scientific attainments, who has devoted many years of his short but useful life towards developing electricity in several forms. One with which we are at present concerned is that which deals with both public and private lighting by electricity. No doubt there are many others in the same field, who have made very important advances in this subject, but no one—I think it is admitted by everybody—has done so much to render lighting by electricity practical and possible as has Mr. Edison. In fact, he has no rival in this so far as I am aware. You have only to look around you for proof of that fact, if you have any doubt. You have only to see what he has done on the Holborn Viaduct, where an area of this city is successfully lighted; and again go to the Post-office, which is lighted from the same centre, and there you will see another piece of successful lighting. A very large portion of New York is also at present being lighted by Mr. Edison's system. When you consider the space lighted in New York from a centre occupies a square mile, which would be, if in London, from about this spot to Charing Cross—that would be one side of the square—you may form some idea of the magnitude of this operation. There is another piece of important evidence on this matter, that amongst all the exhibitors at the general exhibition at the Crystal Palace Mr. Edison was the only one to secure the gold medal for a general system of electric lighting. It is that system of which we have become possessed through the medium of this company, and the object of the company is to give the benefit of it to India, Ceylon, South Africa, and the Australian Colonies. With a view to prosecuting our business we appointed Major Flood Page as our general manager, who occupied the position of general manager of the Crystal Palace for years. He is a gentleman of great energy, and I have no doubt will prove a most successful manager in the position he is now in. No sooner was the company formed than we entered into negotiations with different substantial parties from the colonies with a view to establishing bases of agreements for companies in those parts. I may mention, although it is not desirable to go into these details too fully, that we have entered into negotiations for the formation of a company in the Cape of Good Hope and two of the Australian colonies. At the Cape of Good Hope there is every reason to believe that the company will meet with success. One of the most important and successful of Mr. Edison's installations has been made at the Cape, where the Parliament House was lighted successfully about a year ago; and we have accounts from the Cape, showing how gratified the public are with this successful attempt to carry out electric lig hting there. Mr. Hortsek, who conducted the whole business of the installation at the Cape, is going out to Bombay with a similar installation from this company, to give the people of that place some idea of our system of electric lighting. Major Flood Page left England at the beginning of this month, intending to land at the Cape, and then to proceed to Australia to carry out the objects of the company, and your directors will be very much disappointed if, within a comparatively short time, they do not get some news of a favourable kind from Mr. Hortsek. So far with regard to the business of the company. With regard to electric lighting in general, if I were not a thorough believer in the electric light you would not see me here to-day. I am a firm believer in electric lighting, and I believe most firmly that it will be the light of the future. I think any one who has seen it — and I presume all you gentlemen have had opportunities of seeing it and forming an opinion — cannot doubt that it is the most perfect light that has ever been exhibited or attempted, as to its feasibility and its superiority in every particular over gas there comes the question of cost. This is at the very root of the whole thing, although electric lighting may be very good for persons and places, where it can be afforded, it can only be a general commercial success on the assumption that it is generally employed, and it can only be generally employed at a price similar to gas, or perhaps at a very little more. Now, gentlemen, holding this opinion, I turned my attention to results as to cost. The result of my inquiries was this, that I believe lighting by electricity will

compete successfully when established on a suitable scale with gas, even in England, and in countries where gas is as cheap as in England. This is the result of inquiries I have instituted for my own information, and you will bear this in mind, that gas is something over 3s. per 1,000 feet. If electric lighting can compete with gas, which is at something like 3s. for the 1,000 feet it is quite clear that it will compete successfully with gas where gas is much dearer. Gas at the Cape of Good Hope averages from 12s. 6d. to 15s. per 1,000 feet, and in the Colonies and in India the cost of gas is considerably in excess of the price in this country. Therefore if lighting by electricity is likely to pay in this country, it is all the more likely to pay in the Colonies, where gas is so much dearer. It is one of the advantages of the use of the electric light in the East that it causes a far less raising of the temperature than does the use of gas. Therefore one of the many advantages of the use of electricity is the fact that it reduces the temperature. In the Colonies and India the advantage of the light will be that it is one free from noxious vapours. Holding these opinions, that it is not only a good light, but that it is also an economical light, you will understand that we have entered into the company with the full belief that its operations will be attended with perfect success, and I look forward to meet you twelve months hence with a good and successful report of our proceedings during the year.

Mr. Campbell remarked that the chairman's statement that the cost of gas being much more was very important, but he thought, in order to get at the comparative or relative cost of gas and electricity, they wanted to know what there was in enhanced price for working the dynamo machines.

The Chairman said that coal was by far the largest item in the manufacture of gas, but it was comparatively a very small element in the production of electricity. Of course electricity would be more economical when water-power is obtainable.

Mr. Campbell: That does not apply to Australia, I doubt.

The Chairman: Well, I don't know that it does so much, but it does elsewhere.

No further questions being asked,

Colonel Gouraud proposed a vote of thanks to the chairman, which was seconded by Mr. J. E. Beves, and the chairman having very briefly responded, the proceedings terminated.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

The report of the directors for the half-year ended June 30th, 1882, shows a balance to the credit of profit and loss of £5,889 12s. The receipts were £1,075 12s. 3d. in excess of those for any previous half-year since the formation of the company. The Bilbao cable was interrupted twenty days during last half-year, from April 30th to May 19th. The repairs were very promptly executed and the cable has since been in excellent working order. The cost of the repairs, £2,814 9s. 4d., has been paid out of the revenue of the half-year. The Marseilles-Barcelona cable remained in excellent working order throughout the half-year, and continues so. To meet a considerable accession of business, new offices have been engaged in Leadenhall Street, and will be ready for occupation shortly. The payment of the dividend on the preference shares absorbs £2,921 10s., leaving £2,968 2s., out of which it is proposed to declare a dividend of 3s. per share, free of income-tax, on the ordinary shares, and to add £800 to the reserve fund, which will then amount to £6,000, leaving a balance of £228 9s., which it is proposed to devote to the reduction of the preliminary expenses account.

SWAN ELECTRIC LIGHT COMPANY (LIMITED).

The first statutory meeting of the above company was held in Cannon Street Hotel on Tuesday last, James Staats Forbes, Esq., presiding.

The Secretary having read the notice convening the meeting,

The Chairman said: Gentlemen, this is a statutory meeting. According to the articles of association, within four months of the launching of the company, the directors are to call the proprietors together, not for the purpose of submitting any report of accounts, but simply to conform to what appears to be somewhat of a technicality—probably as a means of introducing to gentlemen interested in these enterprises the outward and visible form of those persons to whom they have thought fit to intrust their interests. This is our first appearance before you as a board of directors. I should be very happy to go through the forms which prevail in polite society of introducing myself and the various other directors. First of all, Mr. Stevenson, M.P., of Newcastle, who has been very much mixed up in electrical affairs, being himself a scientific man; Mr. Batt, a highly-respectable London merchant; Mr. Villiers, director of a very important public company, whose name you will all know; Major-General Trevor, from India, a gentleman of great experience; and perhaps the most important of all, from some points of view, the distinguished inventor of our light, Mr. Swan himself. This is hardly the place, perhaps, to pay a tribute to a man of genius, but we have backed our opinion of Mr. Swan as a man of genius by our investments. He was to me an abstraction till very recently, but what I have had to do with him satisfies me that he possesses, not only the attributes of a man of genius, but also what is rare in such a combination, the attributes of a man of business as well. We are, also, fortunate in securing the services of another gentleman eminent in his way, Mr. Crompton. I need hardly tell you that whatever the confidence reposed in the board of directors who are a necessary adjunct to a representative institution like all joint-stock companies, the real essence of this concern lies in this: whether you have or have not done wisely in, so to speak, backing Mr. Swan and Mr. Crompton, because upon their knowledge and their devotion must ultimately depend the success of this company. Of course it is very early indeed to enlarge upon that topic. There has been a kind of electrical lighting—what shall I call it?—fever, as everybody knows. During the last few months a great many companies have been started, and a great number of predictions have been made. We believe that the Swan lamp is a sound practical thing with a great future. I think it would be almost useless to indulge in prophecy, because burnt bairns dread the fire. I have had to prophesy sometimes in other matters, and I find that if you prophesy right, it is all right, but if you prophesy wrong, you are terribly blamed. But as far as the observation of a non-scientific person and man of business goes, I think that anybody may satisfy himself by going to electrical exhibitions, by going to certain places where the new light is to be seen beside others, that whatever the merits or demerits of other inventions may be, the Swan is an excellent, practical, and beautiful lighting apparatus. You can see it, I think, as pleasantly as anywhere at the Savoy theatre. I do not know whether anybody has been there, but if not one would almost recommend them to go, not only to see the 500th and some odd representation of a very popular burlesque—"Patience" (laughter)—but to see how comparatively comfortable a theatre may be made by the instrumentality of the Swan, not only as affecting the vision, but in regard to the high temperature which often prevails in such places. Apart from the beautiful softness and soothing effect upon the eye, of the Swan, there is always a very low temperature in the theatre lit up by it. All that seems to point to this, that we are possessed of a means of producing a light applicable for any kind of thing—for street lighting if need be, for the lighting of great public buildings, for theatres and halls of every kind, manufactories, coal mines, and steamers. I have had a little to do with rather an interesting steamship just launched—the *Invicta*, which is to ply between Dover and Calais, and I assure you not the very least of her merits is that she is lighted by the Swan light, and a most admirable adjunct it is to a steamer. A great number of ships on some of the principal lines—the Orient line and the Union line—are being lit up, and an application of this light to almost every purpose ashore or afloat seems only a question of time. Since the formation of the company, four months ago, we have had a good deal of work to do. We bought the Swan Company as a going concern, and we also bought certain very valuable patents and had to take them over. We also made an arrangement with Mr. Crompton under which what are called installations, the machinery necessary for producing both the Swan light and the arc light in different places, had to be taken over in virtue of the purchase. That has been all done, and I can tell you that the factories in which these lamps are produced are in admirable working order. We found everything there that we had contracted to buy in proper condition. It has of course involved some little time making the transfer. We have had also to consider the extension of the business, and, without wishing to make any great flourish of trumpets, I may say generally that so far the progress of the concern has been very satisfactory. Of course it is a new thing. We had a great many difficulties to contend with, because a great many persons are competing for the public favour—the Brush, the Edison, and so forth. Whatever the differences may be between one invention and another, we feel that there is scope for the exercise of them all. The field is so wide that there ought to be no jealousy, no conflict. In fact, there is quite enough for everybody to do to carry out this wonderful and beautiful invention. I don't know whether you would like me to go much into details. First of all, the company is formed. Then, the various works have been taken over. We are, of course, not insensible to what is going on. We have had to watch with some care rather an important piece of legislation. It was not very politic or very wise to make any very great display, or to urge forward the business while Parliament was making up their minds as to what was to be the position of these companies in the future. They have only just practically concluded, within a very short time, a particular Act of Parliament which does regulate the position of such companies in the future with regard to the public service. The Board of Trade, happily, I think, took the initiative, which will probably prevent electric light companies from falling into some extravagances, such as, for instance, railway and gas companies fall into. They have laid down certain general principles as to the use of this electric light for public purposes, and we have waited very patiently, and developed our concern prudently and cautiously, as men of business ought to do. Of course we hope between now and our first business meeting to be enabled to produce a statement of capital account, and of working expenses and revenue, which would be more or less satisfactory. There was no reason to believe that it would not be entirely satisfactory. I would be almost inclined to warn you not to be carried away by believing that an enterprise of this sort will produce at first a very great or brilliant profit. One knows perfectly well that some of these companies have acquired very large sums of money by what they call selling their licences and their privileges to affiliated companies. This is a very legitimate source of profit, and one open to us as well as to them; but of course the real base of the prosperity of a company like this must be in the profit we realise upon our daily business—the difference, in fact, between what you receive in the sale of an article and what it cost you to produce it. As far as our experience goes, I think we have no reason to apprehend that there will not be such a difference between the cost of the production of our light and the price of its supply to the public as will leave a very fair, indeed a very good, interest upon your capital. We have not only bought the Swan light and the privileges attaching to its manufacture throughout the United Kingdom and the colonies, but also one or two other things. Every one has heard a good deal about Faure's accumulator, a remarkable invention, coming in aid of the electric light. Mr. Swan had some inventions in connection with accumulators, so had Mr. Sellon, of a very valuable kind. Just as with the lamp, there is a strong family resemblance between all these kinds of accumulators, and it is our good fortune to be in possession, through the agreements entered

into between Messrs. Swan and Sellon, and as part of the assignment to us, of the rights to an accumulator and the power to manufacture it, which will be of the greatest value to us as a company. I will merely indicate that as one source of profit. Any gentleman can see the practical application of such an accumulator on the Brighton Railway, where a train starting is supplied with a certain amount of electricity and is enabled to light itself during a long journey from one end to the other, at a price something within the cost of gas. This is an indication of what the system will enable us to do. All the railways in this country and in European countries will be lit, I feel satisfied, sooner or later with this charming electric light, and in that you see what an outlet for business there is. We possess the accumulator, and without it you cannot get the light into operation. The arc light has a great variety of names—one light has a little advantage this way and another that way—but all are generated by means which appear very simple now, and which are clear enough to the ordinary understanding. We have no antipathies, and no preferences, and no antagonisms. The rule we lay down for ourselves is, having a perfectly practicable and beautiful invention, to studiously find our way how to apply it on advantageous terms for the proprietors. I shall be glad as far as I can to answer questions of a general kind. If any gentleman wishes to ask any scientific questions, Mr. Swan is here to speak for himself; and if anybody wants to hear about dynamo machines and the different kinds of installations, Mr. Crompton will be happy to tell him. I do not think, however, I should sit down without adverting to one subject. You may have seen that some legal proceedings were instituted by the Edison Company against us for infringement. We are not very seriously alarmed on this side of the table about it. The Edison Company are a highly respectable body of people, with no doubt the invention of a very distinguished man. It is a very happy thing for us that we have an Edison in the one hemisphere and a Swan in the other to hit upon inventions which are allied in character though perhaps not the same in effect. We look upon that move of the Edison company as a mere political thing, but I don't think that seriously there can be any doubt as to the entire safety of Mr. Swan's invention. Everybody knows, as a matter of public notoriety, that long before Mr. Edison was heard of, Mr. Swan had actually lectured and exhibited lamps in England, and we apprehend no great difficulty with the Edison company, for this reason: the field is so enormously wide, that no particular body of men, or any particular inventor, can possibly hope to cover it, or to monopolise it for himself, and I think it very likely that we may see, in respect to the Edison and Swan companies, a similar arrangement to that which took place between the Edison and Bell company in the telephone. The two are almost identical. There was an electrical invention of marvellous ingenuity and enormous public value, and there were two inventors, one a Scotchman, Mr. Bell, and the other Mr. Edison. These two companies started in London, and there was talk of litigation on both sides, but the common-sense of the proprietors and directors induced them to do what was of exceeding advantage for both to do—to put their horses together and make common interest. I think something exceedingly like that may take place between the Edison and the Swan (hear, hear.) It is rather fortunate for us that some people connected with the Edison Lighting Company and some of the people connected with the Swan Lighting Company are also people connected with the Edison Telephone and the Bell Telephone. I have the honour of being the deputy-chairman of the Bell Telephone Company, and I am now the deputy chairman of the United Telephone Company, that having been formed by the union of the Edison and the Bell; and I think I may say it, not for the sake of vanity, but to illustrate my previous remark, that it was a good deal owing to me that the arrangement was brought about. The things are so absolutely analogous, the interests are so identical, that I think the same result may follow here. At all events, we do not at all intend to litigate; we would much prefer going on in an honourable, straightforward, gentlemanly competition with other competitors, being perfectly satisfied that all we can do to meet the growing wants of the public in this direction will tax our full powers. All that is very general. I cannot go into figures. I cannot say more than I have said, unless any proprietor will suggest something to me as to further information upon any point. I must sit down without having any resolution to propose or any accounts to submit. If any of my colleagues like to make any observations to the meeting, I am sure we shall be very glad to listen (hear, hear).

After a pause the Chairman said: As the spirit does not seem to move anybody, I shall merely say that we shall prosecute our business in the best shape we can, and having held this first statutory meeting according to our articles, in the course of eight months or so we shall have the pleasure of calling the proprietors together, and then submit to them in proper form the report and accounts of business, whatever it may be at that time. I think that when that time comes we shall be found to have made satisfactory progress. If not, it will not be for want of effort as far as this kind of invention is susceptible of being forwarded, or ability on the part of my excellent colleagues and coadjutors. I ought to have mentioned that there is one other gentleman in the room whose connection with our light ought not to be lost sight of—Mr. Stern, who has been associated with Mr. Swan in the perfecting of this most beautiful light, and to whom, I am sure, Mr. Swan would do full justice for assistance received. He conjoins the position of a man of business with a love and knowledge of abstract science so great that he has been enabled to be of inestimable aid to Mr. Swan himself in the perfection of this lamp. I think that Mr. Swan will be the first to accord to him a share of that inventive faculty, and that wonderfully patient power which has been necessary to develop what seems so simple a thing as a Swan lamp, which you can buy for 5s. (hear, hear). There is no other business except to say that we have fulfilled the statutory duty of calling you together and to thank you for your attendance.

The proceedings closed with a unanimous vote of thanks to the chairman for his able conduct in the chair.

THE DUPLEX ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).

THE first ordinary general meeting of this company was held on Monday last at the offices, 9, Soho Square, Dr. Lilley in the chair.

The notice convening the meeting having been read by the Secretary,

The Chairman said the allotment of the shares took place at the end of May, and the "par" issue was restricted to £30,000. Since then 387 additional shares had been allotted at 10s. premium, thus realising a profit of £193 10s. Suitable premises for the Company's business had been taken on advantageous terms at 9, Soho Square. Arrangements had been made for the manufacture of the duplex incandescent lamp on a large scale, and the execution of the orders for considerable numbers was being proceeded with. The first duplex dynamo had been manufactured, and was now working, making most satisfactory progress. As regarded other duplex appliances good progress was being made, and the directors were satisfied that the company possessed a more complete electric system than any of its competitors. They were ready to adopt any invention of improved merit, provided that no terms were asked for beyond the payment of a moderate royalty, and the provision of proper guarantees for the working of the patents. They did not take up a position of competitive hostility with other companies, but were ready to take the executive orders for any of their systems that individual clients might prefer, the company's profits in such cases being the wholesale trade discounts allowed by the proprietors of the respective patents. Their operations thus covered the whole ground of electrical work, instead of being confined to the single business of lighting. Their general trading department was now in active operation, and already yielding satisfactory profits. They had also begun to take contracts for electric installations in various localities, and had been able to secure the services of a large number of influential local agents; in fact, they had on their books the offer of much more work than they could possibly execute pending the development of their manufacturing departments, and it would necessarily be some time before they could carry out operations on a large scale. He mentioned this to prevent disappointment in the case of shareholders and others desiring electric installations at short notice. These prospects had led the directors to regard with favour the establishment of sub-companies, and they were glad to report that the first of such associations was now an accomplished fact. It had taken the title of the Duchy Duplex Electric Light, Power, and Storage Company, and was to work this company's concessions for the counties of Devon and Cornwall. They had received a first payment of £1,000 in cash and £3,875 in shares for this concession, and were to be paid for their instalments until a total royalty equal to 2d. per head of the population had reached their hands. In addition, the Duchy Duplex had taken over their contracts for the erection of a battery of twenty Duplex mine lamps, with turbine dynamo-electric pumps, electric buddles, &c., and had paid them a cash premium of £500 for the same, while the further business to be done in Devon and Cornwall would lead to a constant demand by the sub-company for dynamos, lamps, and other appliances manufactured and dealt in by the company. Profits to date were as follows:—£193 10s., the premium on shares, £300 for the sale of a contract, and £123 11s. 5d. from miscellaneous sources, making a total of £623 11s. 5d. The concession receipts in cash and shares amounted to £4,875, bringing the total up to £5,692 1s. 5d., and it rested with the shareholders to determine what should be done with these profits. The directors recommended that a dividend at the rate of 10 per cent. per annum and a bonus at the rate of 2½ per cent. per annum should be paid in cash on the 30th inst. on all the cash paid up to that date. They also recommend that the board should be authorised to pay such interim quarterly dividends as they might deem advisable between the dates of the general meetings, and further that the sum of £11,000 (including the £3,875 Duchy Duplex shares) should be placed to reserve. Neither the directors nor the general manager had received any remuneration, and they left it to the meeting to say what would be a fair allowance for their labour. They trusted to receive the hearty support of every shareholder in rapidly building up a large and profitable business. In conclusion, the chairman moved a resolution embodying the recommendation of the directors in regard to the division of profits.

Mr. Holliday seconded the resolution.

Some discussion ensued, in the course of which

Dr. Emmens (the managing director) said, in reply to questions, that there was no doubt that within 12 months they would receive, half in cash and half in shares, no less than £175,000 for the English concessions, so that the shareholders would soon get their capital back, a large bonus, and still retain their interest in the undertaking. Arrangements had been made with two of the leading mines in Cornwall and Devon for the adoption of the company's patents.

The motion was then put and carried, after which a vote of thanks to the chairman and directors terminated the proceedings.

THE JABLOCHKOFF ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

ON Friday, 15th inst., an extraordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel, Jas. Wilson, Esq., C.E., presiding.

Mr. Francis R. Reeves, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, one of the objects we have in calling you here to-day is to inform you that we have made application to the Stock Exchange for a special settlement of the shares of this company, and they proposed certain alterations in the articles of association. The directors consider that they are of a very unimportant character, and you will have no difficulty in agreeing to pass the

resolution at once. The first is to omit the article 16 altogether. The first part is already in article 13, and as to the last part, I presume the directors are bound to do their best to prevent registration of any fraudulent transfer. As the alterations are all in your favour, I don't think there will be any difficulty in agreeing to them. The second is to omit article 20 altogether. It is perfectly superfluous, and there will be no difficulty in omitting that. The third alteration is to omit clause 31 altogether, and it ought not to have been in the articles at all.

Mr. S. Simon: What is to be omitted? Will you read it?

The Chairman read the article, and remarked that the directors were bound, he took it, to prevent any fraudulent transfer.

Mr. Simon: If I had had the articles I would not have asked the question.

Mr. W. W. Lyndall asked whether the shareholders ought not all to have a copy of the articles.

The Chairman said they could have by paying 1s. for them.

Mr. W. W. Lyndall: By paying 1s. for them! Every shareholder, he thought, would not care to pay.

The Chairman said that was by Act of Parliament. Any shareholder can have the Articles of Association on payment of 1s.

Mr. Simon: By paying for it. They were ignorant of the articles. None of them had read those articles.

The Chairman: That is not our fault.

Mr. Lyndall said he was not blaming the chairman.

The Chairman said the notice gave what the meeting was called for. The alteration affecting the transfer of the shares merely threw more responsibility on to the directors. And the fourth alteration was to omit words from article 32, as of course they had no right to forfeit dividends.

Having read clause 20 at the request of a shareholder,

The Chairman said the last change was a proposal of their own, and arose from a printer's error; that was to leave out the word "meeting" between the words "such" and "to" in Article 48, and the insertion of the words, "business shall be given," instead thereof. And supposing these alterations were agreed to, the Stock Exchange would grant them a settlement at once, without waiting for the confirmatory meeting.

A shareholder said he thought such was contrary to the usual course.

The Chairman said that was what was understood, he believed.

Mr. Simon: You mean, they will give us a quotation.

The Chairman: Not a quotation; a settlement.

Mr. Davis remarked that he thought the articles were badly drawn that they should need alteration. Surely they knew the requirements of the Stock Exchange when the articles were drawn.

The Chairman said that, so far as his experience went, he hardly knew any set of articles drawn so as to entirely meet the requirements of the Stock Exchange Committee. Whether they were drawn properly or not the company wanted a special settlement, and the Stock Exchange said, "make these alterations first." He would put it to the meeting "That the Articles of Association be, and the same are hereby, altered as follows:—

"By the omission of articles 16, 20, and 31.

"By the omission of the following words 'and the dividends (if any) forfeited therewith' from article 32.

"By the omission of the word 'meeting' between the words 'such' and 'to' in article 48, and the insertion of the words 'business shall be given' instead thereof."

Mr. Simon seconded.

Mr. Steinthal asked if the chairman would tell him what was meant by a "special settlement" which they were applying for?

The Chairman replied that it was simply that the shares might be dealt with on the Stock Exchange.

The resolution was then put and carried unanimously.

The shareholders then resolved themselves into a general meeting, and

The Chairman said: Gentlemen, you are aware that this, our first or statutory meeting, which we are obliged by the Act to hold within four months of formation of the company; and in so short a time we have not done very much, and there is therefore not much to tell you. I may remind you that this company was formed with a nominal capital of £300,000, that we have been able to obtain from the general public, amounting in all to 400 shareholders, about one half of the capital, and that we found from the numerous demands we have for our lighting, we could employ the whole of our capital, supposing we were able to get it. As soon as the company was formed we took offices at the Winchester Buildings, at a moderate rental. We have appointed managers thoroughly acquainted with the enterprise we have started. I am glad to say we have numerous inquiries besides those of our regular customers, from harbour commissioners, docks, theatres, warehouse proprietors, and private dwellings. In fact, the demand upon us is so great that we have a difficulty at times in filling all the requirements made upon us. As you have seen, we have applied for a settlement, and now we have passed this resolution we shall be able to get one, and that will help us very much in our proceedings. We have also appointed canvassers, who are paid according to the results of their working, in various parts of London, as well as in the northern parts of England and in Scotland. We had to see what the requisitions of the Electric Lighting Bill would call upon us to perform; and those of you who have watched the progress of this bill, will know that this subject has given us great difficulty. We hardly knew what to do in the matter. We have made application to the vestries of London and other local authorities to give us permission to lay our wires in all parts; so we can supply anybody, as a gas or water company would supply gas or water. The Act specifies that before the Board of Trade will give us permission to lay the wires, we must first get the permission of the local authorities. I need not tell you that vested interests are strongly opposed in many cases to any improvement. We hope to get over that, and, in fact, we feel quite sure that electric science is not going to stand still for the sake of any vested interests—gas or otherwise. As to details of the business, you will excuse me if I do not give you too detailed an account. We have many competitive companies who are ready to do lighting almost for nothing, and therefore it would not do for me to tell you our means of defence and modes of operation. You must leave that information for a future time, and I hope we may have good results to show you. We are forming lighting centres in London, and we hope the next time we meet you to show you we are progressing in this respect. The Board of Works have prolonged our contract for lighting the Thames Embankment. They have given us permission to occupy a larger place on the Embankment, and have supplied us with drawings and details, so that we can have a larger engine-power there, and have a greater amount of electric light. We have taken a building on the Albert Embankment for the purpose of making our own candles. That forms the Jablochkoff electric light. Nothing can exceed the simplicity when compared with other electric lights. In all other electric lights there is machinery very complicated, and which must sooner or later get out of order. Others not having so much machinery, fall by gravity as the consumption goes on; but in the Jablochkoff it burns like a wax candle. Once lighted it continues to the end. In the Jablochkoff there is no machinery and no gravity. The consequence is its simplicity must in the future, as in the past, obtain much more custom. These candles are obtained the same as the French company obtained them from another company, which makes them in France, and a great profit is derived from their manufacture. They used to cost 7d. each, they now cost 2d., and they get a profit on that. We hope by making them ourselves to reduce the cost of manufacture and have an equal profit. In these premises on the Albert Embankment we purpose laying down small machinery, and hope to make the candles ourselves at a tremendous reduction on the present rate, and not only to supply our own customers, but also to supply the French company, who have to buy from other makers. The beauty of the light is this: there being no machinery attached to it, it can be worked a great distance with the greatest certainty. That at a mile's distance burns as certainly as one that is near. In all other lights where there is machinery, besides the profit they get in the installation of any new light, which we also get, they have the profit on the sale of a lamp; but once having sold that lamp there is an end to all their profit whatever. No profit comes to any of these other companies until a new lamp is required. In our case our profit arises from a daily consumption of these candles. This is a patent candle, and there is a daily profit from the consumption of it. I hope, therefore, that we shall supply all our customers and also perhaps the French company, who are willing to take their supplies at a less rate than they manufacture them at now. Since the formation of this company also Mr. Jablochkoff, who is a celebrated electrician, came over to this country with a new motor, which we have succeeded in securing from him after having consulted our electrician, Mr. Sabine, who said he thought it was one of the most wonderful things he had ever seen. This will drive any small machine by electricity, whether generated by steam or battery power. It is also in itself a generator of electricity, and can be constructed at such a very small sum, compared to the generality of dynamo machines, that, we hope when once we have succeeded in getting this one from France, and making them ourselves, to supply electric light consumers with a dynamo machine at a very great reduction from what they pay now. More on this point I cannot say now, except that we have three of these machines in France, and hope to get them over shortly. Something has been said by various papers about a difficulty in using incandescent lights in conjunction with the Jablochkoff, and I am glad to tell you we have proved, and I have seen to-day, where a Maxim incandescent lamp has been used in conjunction, and mixed up, with the Jablochoff arc light, that they performed very well together, and I think the difficulty which has been prognosticated as to that is entirely at an end. I have nothing more to tell you than this, and I hope next time we meet you we shall have something good to report to you.

Mr. Sheridan, M.P., asked what steps had been taken towards manufacture.

The Chairman said they had taken the works on the Embankment, which is an admirable position, with a front facing the river, and the back the railway, having storage room behind, and were now entering into a contract for the different small works and machinery.

Mr. Simon inquired whether anybody else could make those candles? Had this company any licence to pay to any other?

The Chairman said they had no licence to pay at all; we have the sole right.

Mr. Lyndall said some suggestion had been made as to the probable sale of concessions by the company. Although the chairman said he did not wish to divulge too much of their business he should like to know whether anything in that way had been done, or whether there was any probability. He thought it would be satisfactory to the shareholders to know if that was the case, and was the amount required by the Stock Exchange to be subscribed sufficient?

The Chairman: Not for a quotation. We have about 400 shareholders holding 19,000 shares of the 40,000 offered for subscription.

Mr. Lyndall asked how much was required?

The Secretary said two-thirds.

M. Pratt inquired if there was any prospect of the electric light being used in the neighbourhood of the Strand or Covent Garden? He had premises there.

Mr. H. B. Sherridan, M.P., asked if the incandescent lamp could be used on the same wires economically?

The Chairman said, as to subsidiary companies a statement did appear in a paper, without their knowledge or consent, stating that they were forming subsidiary companies. There was an idea of forming sub-companies in the North of England and in Scotland, but the directors considered the time was not opportune. They would work the company quietly themselves. They might eventually grant small concessions, but not to large areas, or they would be taking

away the profits which this company might make. With reference to the Strand, they had made arrangements for lighting the Gaiety restaurant; they would shortly get their plant together and be able to light that and other places near. One of their largest shareholders was a gentleman who had used the light between two and three years, and as soon as that company was going to be formed he made application for £5,000 worth of shares. He had proved the light himself for several years. That gentleman had been induced to try at home various lights, but he, along with other customers, had come back to theirs as the best. As far as incandescent light was concerned, that gentleman thought there was nothing to compare with the Jablochkoff, and he had tried several other lights. An incandescent light had been applied in conjunction with the Jablochkoff on the same circuit, and there was perfect satisfaction with the result. These were facts, and not mere theories or ideas.

Mr. Simon asked if there was any profit showing to the company for the lighting of the Embankment.

The Chairman said he could not say much about that. We do not light it for nothing.

Mr. Simon: If you don't light it for anything, there has been a loss.

The Chairman said they had lighted one place for nothing; he did not mind telling them that. It was Charing Cross station. They did not mean to do that any longer.

Mr. Simon said if the company did not get anything for lighting the Embankment there was no advantage.

The Chairman said that the Embankment paid for itself. In the case of Charing Cross railway station, they had done the lighting for nothing, simply because the French company had done the same; but they had given notice to the District Railway that they did not intend to do so any longer, because they were out of the region of doubt, and wanted to be paid for their services. But they had offered to do it for the price which the company paid for gas, and if they were not inclined to pay that, they had given notice that the lights would be put out.

A shareholder said mention had been made of a prior company. What rights had this retained?

The Chairman said they had obtained their rights entirely for England and the colonies. They had the sole right in England and the colonies.

Mr. Terry said he saw no benefit by catechising the chairman in that fashion. They must have time to grow and develop their project. He thought, in the meantime, such questions should hardly be asked.

Mr. Scrutton said that it was the policy of the board not to grant concessions through the country and the provinces, but to employ agents, and make arrangements with private individuals, or with small districts, to take the light. He would like to throw out for consideration the fact that other companies were adopting a different policy, and occupying the ground as fast as they could. They might then find the ground preoccupied if they came to change their minds about granting concessions; and there was no doubt of one thing, that if they were to work from centres well divided, they would work with far greater energy in developing their company than if they were to work from a central office in London alone (hear, hear). If similar companies were formed in the provinces, with efficient directors, they would find it a means of bringing business to the board throughout the country.

Mr. Davis would like to ask what prospect they had of being in a position to apply for a quotation? Also if any promotion money had been paid, and if there was any objection to state what proportion to the present capital was held by the board. He should also like to know what the remuneration of the board was?

The Chairman said he would find that information, first in the prospectus; as to the prospects of the enterprise and as to the remuneration of the directors in the articles of association, which he could obtain for one shilling. As far as regards subsidiary companies, the question had their earnest consideration; and they would not stand still if they thought that the time was opportune, but after four months' experience, they felt quite certain that they must wait a little longer. If this company had been brought before the public one week before it was, they would without doubt have obtained the whole of their capital. But there came a revulsion of feeling. The public got mystified as to the conflicting lights, and suddenly the application ceased. He did not think that since that time there had been a moment in which they should properly attempt to form subsidiary companies. In all cases it would not do to fail, and they had no wish to throw upon the company any expenses at all. As to the auditor the directors would leave the appointment entirely in the hands of the shareholders.

Mr. Terry said, that if they could intrust the board with their money they could surely intrust them with the appointment of an auditor.

Mr. Taylor moved that Mr. Roderick Mackay, of Fletcher and Co., be appointed auditor. Mr. Lawrence seconded.

Mr. Burbage proposed as auditor Mr. John F. French, 26, Basinghall Street. Mr. Scrutton seconded.

Mr. Simon said that the names were unknown to the body of the shareholders, and he thought they had much better leave it in the hands of the directors.

Sir Joseph Mackenna, M.P., had come quite prepared to believe that the shareholders would have names ready; and, therefore, he for one had not thought over who would be a proper man for the auditorship. Their business on the board was to accept the shareholders' nomination; but in the absence of a unanimous selection he would propose for the post Mr. Charles F. Kemp.

The Secretary said he might mention that if gentlemen nominated would not serve, it would be the duty of the directors to call together an extraordinary general meeting to appoint an auditor who would serve.

The Chairman said that the best way would be to put the two names duly nominated to the meeting, and decide the question by the show of hands.

He would therefore put the names of Messrs. Mackay and French before them, and ask the supporters of each to hold up the right hand.

This having been done, the Chairman said he had to announce that the choice of the meeting had fallen on Mr. Mackay.

Mr. W. W. Lyndall said that a large number had not voted at all, knowing nothing about either candidate.

The Chairman said it was not the business of the board to mention any names. As to the remuneration, he might suggest that 25 guineas per annum might be voted (Agreed).

Mr. Marten said that he might point out that it was necessary to have a second meeting to confirm the resolutions passed at this one in about a fortnight. Therefore, if Mr. Mackay did not accept the office of auditor the matter could be gone into again at that time. If notice of the fact were given to the shareholders they would doubtless come prepared with the names of gentlemen who would accept.

On the motion of Mr. Terry, seconded by Mr. Pratt, a vote of thanks to the chairman was carried by acclamation, to which the chairman briefly responded, and the meeting terminated.

BIRMINGHAM AND WARWICKSHIRE BRUSH ELECTRIC LIGHT COMPANY.

THE first statutory meeting of the above company was held in Cannon Street Hotel, on Friday, the 15th inst., George Felton, Esq., presiding. There was not a large attendance of shareholders.

The Chairman said: Gentlemen, I am sorry there are not more shareholders present, but I think the hour of meeting has now arrived. I have to tell you that by our articles of association, and by the Act of Parliament, it is incumbent upon us to meet the shareholders within four months of the registration of the articles of association. We have done that upon this occasion, but like most of the electric light companies we have been unable to execute much business during the first three months. Indeed it has been our work to lay plans as far as possible for the future. Those plans, as far as I am able to do, I will place before you at the present meeting as frankly and as candidly as I know how to do. When this company was formed for Birmingham it found that it was necessary that we should have as far as possible the surrounding district, inasmuch as part of the borough of Birmingham—Birmingham having grown like most other places—was not in the county of Warwickshire. Just about that time an opportunity occurred of purchasing a concession of the Stafford and Worcestershire company. We did so at a cost of £26,000, first consulting our solicitors as to whether we had the power to do so. At the time that was considered a very good bargain. I still think myself, and my co-directors, I believe, agree with me, that it was a very good bargain, inasmuch as, in Staffordshire particularly, we shall have a large mining business. When the Worcestershire concession was turned over to us, a contract, entered into by Mr. Hammond, for lighting the Worcester exhibition, that we considered would be an opportunity for us to advertise the light in that particular district, and we therefore took it over. We are now lighting the Worcester exhibition, and have been for some two months; the whole contract is for four months. The directors of that exhibition have since then given us an order for lighting a horticultural exhibition, so that they appear to be well satisfied with the lamp in the district. In addition to that we have had a large firm in the neighbourhood of Birmingham applying to us for our system of electric lighting. They have been to Worcester, and the manager has expressed himself satisfied with the light such as he saw it at the exhibition. The agreement I was in hopes to have placed before you to-day signed, but it appears that the legal gentleman connected with their firm of solicitors being absent on his holiday, we have been unable to get it signed, but I have here a letter from the manager, which I will read to you. "Dear Sirs,—Your offer was duly considered by my directors at their meeting yesterday, and I am desired to inform you that they are willing to accept your terms if the light will be ready for use in the first week of October. They consider the agreement satisfactory, subject to the approval of our solicitors, and it will be signed probably early next week." We received another letter from him stating that the whole matter is settled subject to the advice of their solicitors. In addition to that we have had negotiations with Coventry and with Burton-on-Trent, with Rugby, and one or two other towns in our district—in Kidderminster particularly. In Kidderminster it so happens that there are three are four streets that are worth lighting, and the Council determined that the remainder of the town should be only lit by gas. The gas company, however, determined that unless the Town Council would give them the whole of the lighting, they would not light the sub-streets alone. Therefore the matter fell through for the present, the contract being renewed for one year only. With regard to Burton-on-Trent, the Town Council have obtained an Act of Parliament enabling them to put up the electric light in the town themselves. We are, however, in communication and negotiation with them, and we hope, indeed I think there is every probability that we shall be the contractors for carrying that out, and if so it would be as remunerative to us as if we put up the lights ourselves. Taking all these matters into consideration, I think that we have done as much as could be expected in three months. (Hear, hear.) We are actually lighting the Worcester exhibition, and we have done it for two months. We have already settled with one of the largest factories near Birmingham for the lighting of their premises, and we are in negotiations for four or five large towns in our district. Therefore I think you may come to the conclusion that the directors and managers have not been idle during the existence of the company.

With regard to the future, there is no doubt about this, that when this company was started, as was said the other day, it was on the crest of a very high wave. Things looked well, while they do not look so well now, according to the records in the newspapers. For

my own part, I believe there is a future for electric lighting. I have had opportunities of seeing electric lighting under very nearly every circumstance. I have had, also, opportunities of seeing nearly every system of electric lighting, and I have come to the conclusion that our own is as good, or, perhaps, better than any other, for street lighting particularly; and we are now putting up an incandescent lamp for house lighting, that, I believe, will be as good as the large arc lamp for outdoors. It is very difficult indeed to say what will be the profit upon electric lighting. We hear chairmen of gas companies get up and tell us that it is impossible that the electric light can ever compete with gas in the matter of price. Well, now, in opposition to that, we have a right, I think, to take into consideration the statements made by those people who are working the electric light themselves. There are private individuals—not companies—who have come to the conclusion that they can get very much better and purer light from the electric light, at a cheaper cost, than they could from gas light. It is cheerful, I think, when we look to the report of Lieutenant-Colonel Festing, the director of the South Kensington Exhibition, who has put the whole matter to the test for 12 months. He has had a machine put up, and has contrasted the price that it has cost during the 12 months with that of gas. We know the electric light, too, is very far superior for fine art exhibitions. We know the deteriorating effects of gas upon valuable paintings; indeed, in some galleries the owners refuse to allow gas to be used. Now, we find that Lieut. Col. Festing saves something like £725 in lighting the South Kensington Exhibition. Here we have an independent testimony, outside electric companies, outside gas companies, outside any influence that could possibly be brought to bear upon a gentleman occupying the position of Lieut.-Col. Festing; and I say that is the most cheerful thing that we, as electric light shareholders, have seen for a long time. I know, myself, one or two private firms who use the electric light, and are doing it at a less cost than gas. It is on these facts that we rely for our future, and not on the reports of gas companies and of gas shareholders. It is when the light is put up independently by private parties, where there is no bias whatever—where they want a good light for the purposes of their business, and find that they can get it at a less cost than gas, that we have a good test of its value. I don't know that I have anything to add to what I have said. I have told you where we have been and what we are doing, and what I think our future may, or should be.

Dr. Mackenzie asked where the Brush system could be seen in operation.

The Chairman said that they might see the light any evening at the Promenade Concerts, Covent Garden, and at the Great Western Railway Station, Paddington.

Mr. Howell inquired what amount of shares had been subscribed for.

The Chairman said that the number of shares issued amounted to £75,682.

A shareholder said that they were acting under a concession from the Hammond Company, and he had been struck by a paragraph in the City article of the *Standard* that morning in which Mr. Hammond informed them of a new invention designed to work not in connection with the Brush system, but in lieu thereof. Had the engineer any information with regard to that new invention?

The Chairman would ask Mr. Hammond to answer the question.

Mr. Hammond said that irrespective of the holding of the Hammond Company he privately held a large number of shares in this company—some 2,000—so that to that extent he was personally interested with its prospects. But he would look out purely from the point of view of the Hammond Company. It was quite true, as pointed out by the gentleman, that the concessions held were held from the Hammond Company and had reference particularly to the Brush machine and the Lane-Fox incandescent lamps. They had always, however, felt that having started sub-companies in any particular district, and got together an organisation for working their agencies there, that it would be to the interests of the Hammond Company to supply the sub-companies with anything whatever that the Hammond Company might afterwards obtain. They were really not under covenant to do it, but they had considered the matter pretty carefully, and they had decided that the fortunes of the Birmingham and Warwickshire Company should be bound up with those of the Hammond Company. He was glad to say with regard to the new invention mentioned, that it was one which would place at the disposal of the company in its patented district, where it reigned supreme, an amount of electric lighting that not till within the last few weeks was hardly dreamed of. He was hardly at liberty at the present moment to give closer details with regard to the machine; but when he told them that it was the joint production of Sir William Thomson and Mr. Ferranti, they would understand how very important it was likely to become. That machine, for incandescent house-to-house lighting, would light something like five times as much as any machine at present in existence. They would see what an important step had been taken towards making house-to-house lighting possible at the same price as gas, and indeed at a very good profit then. He might add that applications were made to the local authority on behalf of this company by the Hammond Company free of cost, because they felt that that work being at their fingers' ends could be better done in that way. They were actively engaged in making the necessary applications under the Act, and it would not cost this company one penny. This being settled, they would be able with the machine which the Hammond Company would hold to compete in the most satisfactory manner possible with gas, and he looked forward to the company's becoming one of the soundest in existence (hear, hear).

On the motion of Mr. Soliagne, seconded by Mr. Postlethwaite, a vote of thanks to the chairman for his conduct in the chair was carried by acclamation.

The Chairman briefly responded, and then called upon the secretary to read the notice convening a subsequent extraordinary meeting, the object of which was stated to be to consider a resolution to alter the Articles of Association as follows:—

1. To cancel clause 40.
2. To omit from clause 41 the words from "the person entitled to the share" to "as the case may be."
3. To omit from clause 112 the words "or otherwise interested."

The Chairman said: The necessity for these alterations arises from our application to the Stock Exchange for quotation and settlement. I believe in very nearly every case these particular clauses have had to be altered, and clause 40 expunged, in consequence of some clerical error. We have consulted our solicitor, Mr. Ince, and he tells us that it is merely a verbal alteration, but to acquire a quotation and a settlement on the Stock Exchange, which is so necessary to the existence of this company, we are compelled to make this alteration. I therefore hope some gentleman will move the adoption of the resolution for these changes.

Dr. Mackenzie, seconded by Mr. Thorp, then proposed the resolution for the alterations suggested. The motion was carried unanimously, and the proceedings terminated.

The Eastern Extension, Australasia, and China Telegraph Company, Limited, notify that they have declared an interim dividend for the quarter ended June 30th of 2s. 6d. per share, or at the rate of 5 per cent. per annum, together with a bonus of 1s. per share, both free of income-tax, payable on the 14th of October next.

Applications have been made to the Committee of the London Stock Exchange to appoint a settling day and allow quotations in the following securities:—Jablochkoff Electric Light and Power Company, Limited, shares (settling day only), and Metropolitan (Brush) Electric Light and Power Company, Limited, shares.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Sept. 20.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	11¼-11¾	[illegible]
		Do. Do.	10	24 - 25	24½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1½- 2	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1 - 1½	
25,000	5	Great Western Electric Light & Power Co.	2½	½- 1½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	8½- 9½	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- ¾	[illegible]
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1½- 2½	
..	..	South African Brush Electric Light & Power Co.	2½	½- 1	
100,000	5	Swan United Electric Light Co., Limited	2	2¼- 2¾	[illegible]
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	51 - 53	
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	82½ 83½	82½
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	20½- 21	
130,000	10	Brazilian Submarine, Limited	10	[illegible]	
16,000	10	Cuba, Limited	10	[illegible]	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	[illegible]- 7	
6,000	10	Do. 10 per cent. Preference	10	[illegible]	[illegible]
65,000	20	Direct United States Cable, Limited, 1877	20	[illegible]- 12	[illegible]
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	[illegible]	11
70,000	10	Do. 6 per cent. Preference	10	[illegible]	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	[illegible]	[illegible]
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	[illegible]	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	[illegible]	
140,000	100	Do. do. registered, repayable 1900	100	[illegible]	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	[illegible]	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	[illegible]	
163,390	10	Globe Telegraph and Trust, Limited	10	[illegible]	[illegible]
163,209	10	Do. 6 per cent. Preference	10	[illegible]	[illegible]
125,000	10	Great Northern	10	[illegible]	
100,000*l.*	100	Do. 5 per cent. Debentures	100	[illegible]	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	[illegible]	
100,000	100	Do. 6 per cent. Debentures, 1886	100	[illegible]	
17,000	25	Indo-European, Limited	25	[illegible]	
38,148	10	London Platino-Brazilian, Limited	10	[illegible]	
12,000	10	Mediterranean Extension, Limited	10	[illegible]	[illegible]
8,200	10	Do. 8 per cent. Preference	10	[illegible]	
9,000	8	Reuter's, Limited	8	[illegible]	
280,000	Stk.	Submarine	100	[illegible]	
58,225	1	Do. Scrip	1	[illegible]	
4,200	Cert.	Submarine Cables Trust	100	[illegible]	
37,350	12	Telegraph Construction and Maintenance	12	[illegible]	
150,000	100	Do. 6 per cent. Bonds, 1884	100	[illegible]	
186,750	5	Do. 2nd Bonus Trust Cert.	5	[illegible]	
30,000	10	West Coast of America, Limited	10	[illegible]	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	6¾- 7½	[illegible]
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1½- 2	
34,563	10	Do. 6 per cent. 1st Preference	10	8½- 9	
4,669	10	Do. 6 do. 2nd do.	10	7½- 7¾	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	[illegible]	
300,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	[illegible]	[illegible]	
100,000	5	United Telephone Co.	[illegible]	[illegible]	

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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NEW DYNAMO-ELECTRIC MACHINES.

Electricians and the public generally are just at the present moment greatly interested to learn more of the new dynamo-electric machine about to be introduced, and which is stated to be the joint production of Sir William Thomson and Mr. Ferranti. More correctly speaking, we believe that both inventors worked out their ideas independently, but that in the one patent there is something which is wanting in the other; therefore, to be more completely successful, the patentees have combined their efforts with the result of effecting—so it is said—a revolution in such machines. We do not suppose that the promoters of the new invention expect to obtain a greater electrical efficiency from the machine, in proportion to the power taken to drive it, than can now be obtained from the best machines of the present day; but even supposing there are others as good electrically, a great step in advance has been made if the cost of construction, and therefore the selling price, is materially reduced, and this we understand is actually the case. In our "Notes" columns last week it was stated upon the authority of those directly interested in the Ferranti-Thomson invention that it produced four times (nearly) as much work in the external circuit for incandescent electric lamps as the machines of Brush, using in each case the same horse-power. If this is a fact, then the latter machine must have a very low electrical efficiency externally, probably not exceeding 20 per cent. of the engine-power expended. We cannot however quite credit the above comparison of the two systems, especially if the Brush machine were constructed for the special purpose of employment with incandescent lamps.

Mr. Hammond's statement to the effect that the Ferranti-Thomson machine is five times superior to others was, we find, purely of a commercial character. He argues that if a dynamo-electric machine costing £250 and sold for, say, £750 is compared with another, equally good electrically, costing £50, and which can be sold for £150, the one is five times as efficient as the other, or what comes to the same thing, one might purchase for the price of the £750 dynamo-electric machine, five smaller machines doing individually the same amount of work as the larger one, and, therefore, obtain for the same outlay five times the amount of work. The matter, however, ends at the first cost, as the expense of motive-power would be five times as great for the multiplication of work done. Mr. Hammond, in his remarks, does not take into account that one machine is of the alternating current type, and that the other produces a continuous current, neither does he mention that an exciter would be employed to magnetise the field magnets of the new machine. One point gained by Messrs. Ferranti and Thomson in the revolving armature proposed by them is its low internal resistance. In fact, we should have here a machine which practically eliminates an element which in nearly all other arrangements reduces the percentage of what should be useful work to a considerable degree. Again, as there is no iron in the armature, rapid reversals of magnetism, which in certain alternating current machines produce considerable heating, is thereby avoided. It remains to be seen, however, to what degree of perfection the cheap production of electricity has arrived by means of this invention, but it appears certain that a great step in advance is about to be attained, and that by its means the ultimate success of electric lighting will be much enhanced.

ELECTRICAL INTERCOMMUNICATION ON RAILWAY TRAINS IN MOTION.

By W. H. Floyd, M.S.T.E.,

Superintendent of Telegraphs, Great Indian Peninsula Railway.

Although twenty-seven years have passed since the first attempt was made in England to establish an electrical intercommunication on railway trains in motion, and several plans have been brought forward with that object from time to time, it can scarcely be said that any electrical system has been so thoroughly tried under varied conditions, as to give complete assurance that it may be relied upon to satisfactorily afford communication between passengers, guards, and engine drivers on railway trains in India. The first practical system of electrical intercommunication brought forward in England was introduced by Mr. W. H. Preece in 1864, but, although it was successfully tried on the London and South-Western and other lines of railway, it was prevented from coming into extended use by the preference of railway authorities for the mechanical arrangement known as the "cord" system, that was conditionally sanctioned by the Board of Trade in 1867.

In 1865 the South-Eastern Railway Company adopted an electrical system of intercommunication, introduced by the Company's Telegraph Engineer, Mr. C. V. Walker, and that system has, it is believed, worked satisfactorily ever since under Mr. Walker's supervision.

In the same year Messrs. Varley and Martin patented an electrical system of intercommunication, and the royal train on the London and North-Western Railway line was fitted with it.

A train running daily between London and Wolverhampton was also fitted with this system, which is said to have worked regularly and well for nearly two years. At the end of that time the train was called in for repairs, and its successor was fitted upon the "cord" system.

In 1872 an electrical system was introduced by Colonel Binney on the Great Eastern Railway.

Between 1872 and 1878 no fresh plans were brought forward, and, in the latter year, it was said that only two systems of the four mentioned remained in practical use—viz., Walker's on the South-Eastern Railway, and Preece's on the London and South-Western.

Since 1878, however, some of the London, Chatham, and Dover Railway Company's mail trains have been fitted with Varley and Martin's system.

The Preece, the Walker, and the Varley-Martin systems resemble each other in the particular that with each of them only one insulated wire is employed; the railway metals and screw-coupling drawbars being relied upon to provide a return wire, or earth connection; and they are all worked on the electrical principle that was first applied to this kind of communication by Preece in 1864; but each has a different method of coupling the insulated wire between vehicles, and a different kind of alarm communicator for the use of passengers.

The Preece coupling rope is formed of three stranded copper wires, insulated with india-rubber and covered with a thick plaiting of hemp. This rope is brought from the insulated line wire through the buffer beam of one vehicle, and has at its free end a galvanised iron eye that engages with a gun-metal hook fixed on the buffer beam of the oppo-

site vehicle, and is pressed firmly to it by a strong flat spring.

Each buffer beam has a coupling rope at one end, and a gun-metal hook at the other, both connected to the insulated line wire, so that a double electrical connection is made between vehicles, and the couplings are always ready for joining, no matter which end of a vehicle is presented.

The Walker coupling is a hard brass wire spiral enclosed in a vulcanised india-rubber tube. The spiral has a brass ring at each end, and a brass hook to receive the rings is connected with the insulated line wire and fixed at the centre of each end of a vehicle near its roof. These couplings are removed at the end of a journey and transferred to another train, or stored.

The Varley-Martin coupling rope is made by wrapping seven wires round seven hempen cords, each wire round its separate cord, and making them into a rope bound together by two servings of hemp soaked in an insulating compound. Malleable cast-iron eyes are attached at the ends of the connecting ropes, where the couplings are made, and these pass over and are firmly grasped by strong malleable iron hooks, actuated by powerful springs placed in cast-iron boxes attached to the carriages. The eyes are coated with copper, and the hooks with brass, at the points of electrical connection.

With this coupling, as with the Preece coupling, a double connection is made between each vehicle.

None of the three couplings described will give any signal in case a portion of a train is separated on a journey, but each inventor has a plan for providing such a signalling arrangement where it is required.

Colonel Binney employed two wires for his system of intercommunication, as it was tried on the Great Eastern Railway in 1872. The wires were led over the roofs of the vehicles, and connected by a hook and eye and flat spring between them.

Description has been confined to the various kinds of coupling employed by inventors of electrical systems of intercommunication, because the coupling is the only really difficult part of any such system. Once a simple and effective coupling for the insulated wire is secured, it is only necessary, for the establishment of satisfactory intercommunication in a railway train, to have strongly made bell and battery arrangements, that will stand the shaking given to them by the moving train, and to keep the apparatus under efficient supervision.

The method of making the electrical connections to the bells and batteries employed will depend upon what facilities for intercommunication are required.

If it is sought only to provide that passengers and guards may ring to the engine driver, an electric bell, without battery or contact maker, will be required on the engine, a battery and contact maker in the front brake van, a contact maker only in the rear brake van, and an alarm communicator in each compartment of the carriages whence it is intended that passengers may ring to the engine driver.

But, if it is intended that passengers shall be able to ring to the guards as well as to the engine driver, that guard may ring to guard or driver, and that the driver may ring to the guards, it will be necessary to have an electric bell battery and contact maker on the engine and in each guard's brake van, as well as an alarm communicator in any compartment of a carriage whence passengers are to be allowed to ring the bells.

This plan is herewith illustrated, together with a method proposed by the writer for connecting an indicating bell to direct the guards to the compartment of a carriage whence an alarm has originated. A train composed of an engine, thirteen passenger coaches, and two brake vans has been fitted up on the Great Indian Peninsula Railway in the manner shown by the diagram (fig. 1), and is running daily on the local service between Bombay and Kalyan, in order to ascertain by experiment whether an electrical system of intercommunication will meet the requirements of Indian railway traffic, and to practically test a form of coupling for connecting the necessary insulated wire between carriages and an alarm communicator that have been recently designed and patented by the writer.

The coupling now under trial upon the Great Indian ... Railway was designed especially with a view to ...s that have their composition varied many times during a journey, as is the case with the mail and other through trains upon that line. With such trains the risk that a shunting porter may forget to unhitch anything that will not prevent vehicles from separating, is repeated so often during the run of a train, that it is very important to have the electrical coupling for intercommunication purposes

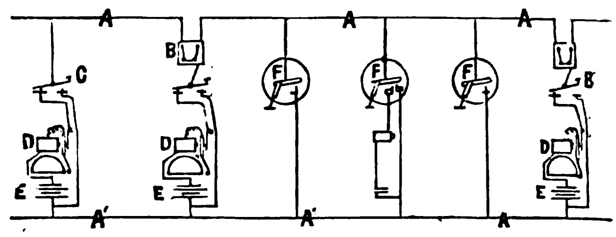

FIG. 1.

Diagram showing electrical connections in a train composed of one engine, two brake-vans, and three carriages. Centre carriage fitted with local bell and battery to indicate where alarm originated.

A, line-wire. A', return, or earth-wire. B, switch. C, contact maker. D, electric bell. E, battery. F, alarm communicator for carriage, *not* fitted with local indicating bell and battery. F', alarm communicator fitted with local indicating-bell and battery.

so arranged that if the shunter should forget to cast it loose it will become uncoupled immediately one vehicle moves away from another, and will not become damaged in the process.

The coupling (fig. 2) is formed by two pieces of metal

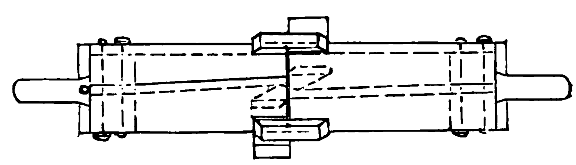

FIG. 2.

Coupling to connect insulated line-wire between vehicles.

tube, each 3 inches in length and $1\frac{1}{4}$ inch in diameter, and closed at one end. A strong flat spring, fixed at the closed end of each piece of tube, projects half an inch beyond the open end, and carries at its free extremity a wedge-shaped piece of metal.

When two pieces of tube are brought together, and one wedge-shaped piece is forced over the other, as shown in fig. 2, a good electrical contact is made and the coupling is complete.

There is a slotted piece on one side and a stud on the other of each piece of tube to act as guides and to prevent any circular movement of the parts after they have been connected.

The insulated line wire is fastened to a ring at each end of the complete coupling, and is carried thence to the centre of the width of the carriages at such a height as to be well clear of the screw couplings and side chains of the vehicles. The coupling hangs in the centre of the space between two vehicles, and can only be separated by a direct strain. The amount of the strain required may be regulated by the strength of the springs in the tubes, and the shape of the wedge piece. The couplings employed on the Great Indian Peninsula train separate at a direct pull of 20 lbs.

For the return or earth wire the writer prefers to use the permanent way rails connected *viâ* the wheels of the vehicles of the train, and supplemented by the screw coupling drawbars joined together underneath each carriage by wire spirals, but if such an arrangement should prove to be unreliable in India, as has been suggested—although it has been found perfectly reliable in England for the past sixteen years—the coupling under description may be readily made to couple up a return wire as well as the insulated line-wire. For this purpose it will only be necessary to fasten the fixed end of the flat spring of each piece of tube in a block of ebonite instead of in metal, thus insulating the spring from the tube. Then the spring will couple the insulated line wire; and the metal case, slotted pieces, and studs of the tubing will couple the return wire; thus the rails of the permanent way will no longer be required to complete the electrical circuit. In connection with m... of the elec-

trical systems that have been brought forward provision has been made for giving a signal in case any part of the train should become separated, but, so far as the writer is aware, none of the plans for that purpose have been brought into practical use upon railways. It is an objection to such a signal that unless some more or less complicated machinery is added to the ordinary electrical apparatus employed in intercommunication systems, the signal given when part of a train breaks away must of necessity appear to engine drivers and guards exactly like the signal given by a passenger whose alarm communicator is intended to give a peremptory order to stop the train; therefore there would be risk that the train might be stopped by a break-away-signal being mistaken for a passenger's signal, and a collision might result from the hinder part of the train that had separated running into the foremost part. Such liability to mistake, and consequent danger, might perhaps be prevented by some such arrangement as the following.

In each carriage have a train of clock-work to drive a small wheel that has parts of its periphery insulated, and parts making rubbing contact with a flat spring, every time the wheel revolves. Connect the wheel and spring in the intercommunication circuit.

Arrange passenger's alarm communicators in each carriage, so that any one of them will start the train of clockwork when a passenger gives an alarm signal. Then the ringing of the bells on the engine and in the guards' brake vans, instead of being continuous will be interrupted at regular intervals, and thus clearly show that the alarm signal has been given by a passenger.

Each carriage may have the periphery of its clockwork wheel differently insulated from the others, so that signals given by passengers will not only be identified as such, but the particular carriage that a signal comes from will also be told to driver and guards.

But such a plan would be somewhat expensive, and would introduce complication where extreme simplicity is much to be desired. As, however, railway authorities who regard a break-away signal as an important requirement of an electrical intercommunication system in trains, may see some way of overcoming the difficulty proceeding from similiarity of signals without incurring serious expense or introducing complications, the writer has devised an adaptation of his coupling that provides for a continuous signal identical with that given by a passenger being given if any part of a train should become separated on a journey.

In this adaptation of the coupling the springs are insulated from the tubes, so that neither the permanent-way rails nor the screw couplings are brought into use to complete the electrical circuit for the intercommunication, and a small lever is so arranged in each piece of tube that it is insulated from the wedge-shaped piece on the flat spring as long as the coupling remains connected up, but immediately the coupling is separated the small lever is forced hard on to the wedge piece, and makes full contact between the insulated flat spring connected to the line-wire and the metal case, slotted pieces, and studs connected with the return wire. Thus the bells on the engine and in both guards' brake vans will ring continuously, precisely as they would do if a passenger had given an alarm. It is claimed for the coupling described above that it is simple in construction and very strong, that it may be made of inexpensive materials—the cases may be made of iron gas-pipe, if desired—that it assures perfectly safe electrical contacts which are cleaned by the separation, or re-connection, of the coupling—that it may be used either with or without employing the rails of the permanent way for a return wire, and that it may be readily adapted to giving an alarm in case part of a train should become separated on its journey.

Also that, by means of spare lengths cf insulated wire rope having a half couping at each end, any number of vehicles not fitted with the electrical intercommunication system may be bridged over, so that they will not interfere with signals passing through the electrically fitted portion of the train: and that any description of rolling stock may be fitted with the electric rope and couplings as quickly as it could be fitted with the "cord," so that railway companies employing the writer's system need only have electric ropes permanently fixed to stock that is constantly running, or that is required to be provided with alarm communicators for the use of passengers; vehicles only occasionally running remaining unfitted with electric ropes and couplings, except when they are actually in work.

The alarm communicator, fig. 3, to be fixed in railway carriages for the use of passengers, has a neat teakwood case—not shown in the figure—from which only the cross-piece, H, projects. A passenger having pulled this cross-piece downwards once, the tongue, T, is removed from a slot on the lever, L, and the latter, being released, falls upon

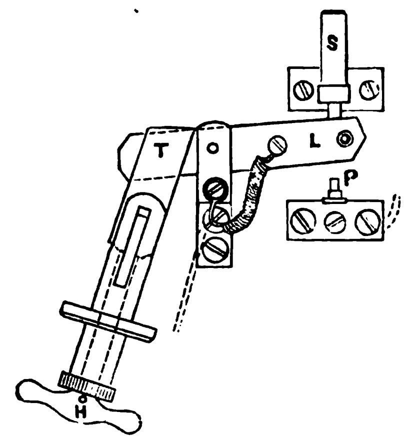

FIG. 3.—ALARM COMMUNICATOR.

the contact point, P, assisted thereto by the helical spring enclosed in the tube, S, thus connecting the line-wire with the return wire or earth (*see* fig. 1) and causing the bells on the engine and in the brake vans to ring continuously until the guard unlocks the teakwood case and restores the lever and handle to their normal positions. The passenger cannot put the handle back until the case has been unlocked, because the tongue, T, cannot enter the slot on the lever, L, until the latter has been lifted clear of P.

In case it is required to have an indicator to direct the guards to the particular carriage whence an alarm has been given, the alarm communicator lever, L, is slightly lengthened, and an additional contact point is placed alongside P, but insulated from it—this extra contact point connects with a small electric bell, and thence with a battery that is connected with P (*see* fig. 1). Then, when a passenger releases the lever, L, it falls on both contact points, thus establishing its own circuit as already described, and also completing a local circuit that causes the small bell in the carriage to ring out a direction to a guard passing alongside the train as to where he should look for the originator of the alarm signal.

The switch shown in each brake van (fig. 1) is to enable the front guard to communicate with the engine driver only, without ringing the rear brake van bell, or to communicate with the rear guard only, without ringing the engine bell. For the former purpose he disconnects the bar nearest to the rear of the train from its lower terminal, and keeps the bar nearest to the engine connected up as shown in the diagram, and for the latter purpose he disconnects the bar nearest to the engine, and keeps the bar nearest to the rear of the train connected up. The switch is only required in the front break van, but as any brake van may be placed in front of a train, it is necessary to fit every vehicle of that class with a switch.

ON CONTACT ELECTRICITY GRADUALLY DEVELOPED UNDER CO-OPERATION OF THE AIR.—By W. Holtz.—The author stretched out an insulated sheet in the air, and placed it in connection, by means of a wire, with the lower plate of a condenser, the upper plate of which was conducted off. If the wire touching the sheet was of copper, the electroscope, after a time, indicated positive electricity; but if it was of zinc, it indicated negative electricity. At times the electric movement was manifest after a short time, but on other occasions only after the lapse of hours if the air was moist, and especially if it contained ozone. Various modifications of the experiment left it free from doubt, that the ultimate source of the electricity was the contact of the sheet and the wire.—*Wiedemann's Beiblätter.*

EXTRACT FROM SPECIFICATION OF PATENT FOR ELECTRIC LIGHTING.

[Dated 6th July, 1852. No. 14,198. By MARTYN JOHN ROBERTS.]

THE following description of an Incandescence lamp sent to us for publication by a friend will be found interesting to our readers. The "Roberts" Arc lamp can be found in the admirable work just issued by our Contemporary *Engineering* on "Electric Illumination."

"Another part of my invention consists of a mode of obtaining electric light by passing a current of electricity through a thin piece of graphite, coke or carbon, or other infusible body, being a conductor of electricity, while it is enclosed in a vacuum or space not containing any oxygen or other matter which can cause the combustion or destruction of it to be brought into an incandescent state by the action of the current of electricity.

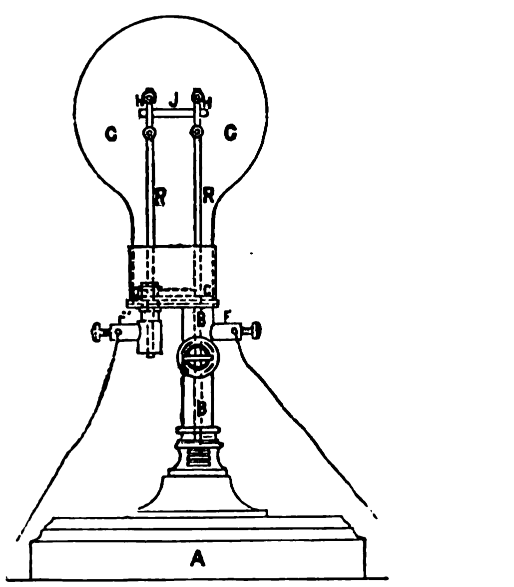

FIG. 5.

"In fig. 5, I have shown an elevation or side view of an apparatus which may be used for this purpose, but I desire it to be understood that I do not claim any of the elements or parts of which this apparatus is composed, apart from the combination thereof. In this figure, A is a stand, upon which a hollow pillar or tube, B, can be screwed; this tube is furnished with a stopcock, S, by which its passage can be closed air-tight. On the top of the pillar is a screw, C, about one and a half inches in diameter, which receives the neck of the globe, G, also furnished with a cap and screw to allow it to be screwed air-tight down upon the tube, B. The tube, B, has a binding screw, F, soldered to it for the purpose of making connection with a galvanic battery, and the tube is also in metallic connection with a rod, R, having at the end of it a clip, H, for the purpose of holding a piece of graphite or other substance, through which I wish to pass the electricity. Another rod, R¹, also furnished with a similar clip, H, passes through the head of the pillar or tube, B, but is preserved from coming into metallic contact with it by having the rod enveloped in ivory or other non-conductor of electricity. At the bottom of the rod, R¹, is another binding screw, F¹, for the purpose of connecting it with the other pole of the battery. Now, the mode of operation with this apparatus is as follows:—A piece of very thin graphite, about half an inch long, half an inch wide, and as thin as conveniently can be made, is fastened at each end into the clips, H and H, and firmly secured; the globe, G, is screwed air-tight upon the pillar, B; the stopcock, S, opened; and the whole apparatus, by a screw at the bottom of B, screwed down upon an air-pump or exhausting syringe; by this the air is drawn out of G, and as perfect a vacuum as can convenie [illegible] obtained; when this is done, the stopcock [illegible] he apparatus is then removed from the pump to its stand, A, and a galvanic battery is put into connection with it by the binding screws, F, F¹; the electricity passes through the rods, and the thin piece of graphite, J, which becomes white-hot from the passage of the electric current, and no combustion will ensue if the vacuum be perfect and no matter within the globe to cause combustion of the graphite; or if the graphite be not otherwise destroyed, the light continues as long as the electricity flows through the graphite in sufficient strength.

"And with respect to this part of my invention, I claim the production of light by passing electricity through a thin infusible body, being a conductor of electricity, in manner hereinbefore mentioned.

"Another part of my invention consists of a mode or modes of giving increased brilliancy to the light produced by electric lamps.

"I have discovered that flame, or the combustion, or volatilisation of some substances, between or on the points of the electrodes, will very much increase the light produced by an electric lamp. Thus, if a candle or lamp be placed so that its flame shall pass between the points of the electrodes, the brilliancy of the light evolved between the electrodes will be increased; or if lime or any other alkaline earth be interposed between the electrodes in this manner, I prefer to effect that object in the same manner as lime is introduced between two jets, in what is usually called the Drummond light; I prefer, however, to produce the same, or nearly the same effect, by a new description of electrode, which I make by mixing the material of which the electrodes may be composed with a portion of lime or other alkaline earth (I have used about 5 per cent. of lime with success), taking care not to introduce as much as will materially diminish the power of the electrodes to conduct electricity. When electrodes thus made are brought into action in the lamp, they produce a light very much more brilliant than electrodes made without any such admixture."

The similarity of this latter arrangement to recent patented devices will be obvious.

THE BRITISH ASSOCIATION.

[*Specially reported for the* ELECTRICAL REVIEW.]

THE EFFICIENCY OF THE EDISON STEAM DYNAMO.

[Paper read before Section G, Monday, August 28th, 1882, by Dr. FLEMING.]

EXPERIMENTS were carried out during the month of June last, at the central station of the Edison Electric Light Company, London, by Dr. Hopkinson and myself, on the efficiency of the steam dynamo which supplies the current for lighting their district. The results which we obtained appear to be in accordance with some others obtained in America. Four machines only are in existence in Europe of the type used at the Holborn headquarters. The first was exhibited in Paris, the second and third are now in London, and the fourth is on its way to Milan, together with another machine, for supplying 2,000 lights to the theatre there. They are all of the same general type, though, with certain slight modifications, the machine is, of course, simply a revolving armature, in which the conductors are not wires but copper bars. This revolves in the field of a very powerful magnet, or rather of a series of 12 magnets, which are coupled six in series, and then joined in parallel arc. The current is taken off by brushes. In the first machines there were only three brushes, in those now employed there are four; in the machine going to Milan there are five, of about 2½ inches wide. The effect is to reduce the sparking very considerably, and the machine runs with its full load sometimes almost entirely without a spark.

In our investigations we intended to elicit an answer to the question: What horse-power fraction of the power employed in turning it comes out of the dynamo in the shape of electric current—including the part that is used to supply the magnet? The engine is a Porter-Allen of the usual type, which turns directly upon a shaft which runs direct through four bearings. Our first attempt was to measure the power applied on the axle of the armature. For that purpose we used a high-speed indicator. As the speed is 290 to 300 revolutions a minute, the indicator turns six times a second. We took it at various times with various conditions of load. Many of the diagrams we got had to be rejected, but we got some that were good, and these were collected and copies made by the electric pen. They were laid down and a stencil proof taken, and from that the horse-power was taken off very accurately. At the same time there were recorded the pressure in boiler, speed of engine, load of lamps, and the time at which the observation was taken. Very special

arrangements were made to ascertain the exact number of lamps in the circuit during the observations. They were scattered through the whole district, and could not, of course, be stopped at any given moment after they had been started for the night. We were not able to contrive a shunt at that time to measure the power generated, and also the difference of potentials between the two poles, but we got at these results in an indirect way. We were enabled to measure not only the difference of potentials between the two mains, but the current flowing, and, therefore, we had the means of knowing the energy expended in the circuit. Simultaneously with these observations we made others on the candle-power of the lamps, so as to keep that constant in our calculations. Of the current which comes out of the dynamo, more or less, can be thrown into the magnets; and, by altering the current, the whole of the lamps can be raised or lowered so that they can be kept constantly at 16-candle power. Experiments with the series of indicated dynamos were taken to indicate the power consumed simply in turning the machine at a normal speed when no current was generated. For that purpose the switches which connected them with the magnets, and also the main circuits, were opened, and the engine was run at its speed of 290 to 300 revolutions. The results observed were plotted down as a curve in a large diagram, where the abscissæ were taken to represent the number of lamps and the ordinates the horse-power. Immediately after that the field circuit was closed, the external remaining open. So that the diagrams taken represented the difference between the two energies or the horse-power employed or consumed in maintaining the current in a field magnet, and also local currents in the coil and armature. That difference we found to be 19·77 horse-power. With these safeguards, then, we found that for 200 lamps we had an expenditure of 43·45 horse-power; for 600, 105 horse-power; for 800, 117 horse-power; for 1,000, 145 horse-power. Deducting the 19·77 horse-power occupied in charging the field and overcoming the friction, a total of 125 horse-power remained as occupied in maintaining 1,000 lamps. The result, therefore, is that, after overcoming the friction, the addition of eight 16-candle lamps makes a difference of one additional indicated horse-power. The efficiency so stated is a compound efficiency—partly of dynamo and partly of lamp. The 10-candle lamps have a resistance of 200 (20?) ohms when hot, and the 16 only 140 ohms, so that with only half the current and horse-power the latter yield 25 per cent. more light. To separate the efficiency of the dynamo from the lamp, we did not, for want of time, make accurate experiments to measure the current directly, but we made arrangements for ascertaining what was the actual current going out. We could get this from our diagrams. The observations on the difference of potential between the poles of the machine showed that the machine was generating 105·5 volts as the mean. The resistance of the field-magnets taken as the constant is 6·73 ohms. The magnets are twelve in number, and the coils are coupled six in series and two in multiple arc. Therefore the energy represented by the current in the field is $\frac{105\cdot5^2}{6\cdot73}$, or 1,654 Watts, or two horse-power. The total power was 19·7 horse-power. Deducting from this 8 for friction and 2·2 represented by the energy of the field current, we have 9·5 as waste in local current and in the armature bars. We have, then, on the whole, 17·56 horse-power as ineffective in producing current when the dynamo is running with 1,000 candles. The total horse-power ought to be 125. The efficiency of the dynamo is the difference, or 88 per cent., or nearly 90 per cent. This efficiency increases with the number of lamps, and as the machine will bear loading up to 1,300 before the external resistance becomes too small, and the armature begins to heat, a slightly higher efficiency can be obtained. Special tests on the efficiency of the lamp, to determine the actual horse-power expended in the carbon, showed that with a lamp of the old form burning at 16 candles, the electromotive force 105 volts and the current per lamp ·7 of an ampère, the result was 73·85 Watts = 1-10th horse-power as the energy expended in the carbon itself. From the horse-power curve another useful series of facts could be obtained. We were able to plot another curve, of which the abscissæ represented *time* and the ordinates *horse-power* equivalents, so as to express the work of the engine in horse-power hours. Other experiments of less general interest were made at the same time on the efficiency of the boiler. The results, therefore, carried out with very considerable care, show that this dynamo has the power of converting into energy of electric current some 90 per cent. of the energy applied to turn the armature of the machine.

The President said that it was only upon such experiments as these that the public were enabled to form an opinion on the subject. Discussion being invited,

Mr. Blakeley said that they did not yet know the exact laws upon which the transmission of energy took place. He had never seen a satisfactory expression for the work of one of these machines, from which one could deduce the connection of the current with the velocity and the resistance which were the three variables in the problem which the engineer required to solve before he could be thoroughly answerable for the action of these machines. They heard a great deal about the characteristic curve of a machine; here it had been furnished by a series of experiments which only supplied what ought to have been known without them. Problems in dealing with current velocity of revolution and resistance ought not to depend on experiment for their solution. He had himself endeavoured to analyse published figures on the subject. One of the chief things which he really wanted to know was, "Is the alteration which occurs in the magnetic field produced by the revolving armature considered as a metallic mass?" This was most important for the problem, because the effective magnetism is one of the factors in the evaluation of the magnetic force. The best attempt to settle that law had been made by Mr. Siemens and described in a paper given before the Society of Arts in May, 1881. That paper assumed the reduction of the magnetism from what it would be when the armature did not revolve in the field, to be proportional to that magnetism and to the velocity of rotation. But it has since been shown that the velocity of the following machine is greater than that of the driver, a very odd thing indeed, and one which entirely did away with the hypothesis of Mr. Siemens that the magnetism in the second machine would be increased by the revolution of the armature.

Mr. Macknight, Edinburgh, followed with a few remarks on the practical results of these machines as exhibited in actual lighting, contending that frequently the cost of the system was a bar to its adoption.

RECENT PROGRESS IN ELECTRIC RAILWAYS.

[Paper read before Section G, Monday, August 28th, 1882, By Dr. FLEMING.]

Mr. EDISON has for some time been struck by the economy involved in an electric system of transport, and has set himself to design an electric locomotive, taking as his type the ordinary steam locomotive, only he has taken out all the interior mechanism and replaced it by mechanism appropriated to drive the machine by means of an electric current. The general scheme by which this has been done is as follows:—At a certain station there are a series of dynamo machines of the well-known patent of Edison capable of supplying 250 of the ordinary 16-candle incandescent lights. A battery is set up at a central station with mains proceeding out at different points on the railway. The current, when it has entered the circumference of the wheel, passes up into the central hub, and so is taken off by brushes into the dynamos placed in the interior of the engine. Hence it is necessary to have the centre of the wheel insulated from the tyre. The dynamos in the interior are of the same type as made by Mr. Edison for lighting purposes. The armatures are wound on the Siemens principle, and the same peculiarity is preserved in the dynamo of making what Edison calls a large intervening mass of iron. The locomotive, which is attached to the train of cars in the usual way, can be started or stopped by shunting the current into the dynamo, and by varying the external resistance in the field circuit of the dynamo, the engineer or locomotive driver has the power of regulating the speed of the engine. Mr. Edison has so far succeeded in his experiments that they are now travelling on this railway at 40 miles an hour in Menlo Park. The most important question of course is whether this system is or is not more economical than the ordinary steam locomotive, and Mr. Edison's statements as to this are based on the doings of the ordinary locomotive of the best type. In such a locomotive it is not possible to get one indicated horse-power with a less consumption than 6 lbs. of coal per hour, when special attention is given to the firing and running. With careless firing it is possible that there will be a great increase in the consumption of the coal, owing to loss of coal or coke through the funnel. But under this arrangement you can, as it were, transfer the consumption of the coal from the fire-box of the engine to the central station, at which the stationary engines will be of a far more economical type. By using condensing engines of the best type and taking very careful means to economise the consumption of coal, it can be got down to something like 2½ lbs. per horse-power per hour. Therefore there is in the first place a large saving in coal—though it remains to be seen whether what is thus gained is not lost in the transformation of the energy of the coal into electric current. Careful experiments have yet to be made to ascertain the efficiency of the dynamos used: what proportion of the coal-power is transformed into electric current. Some recent experiments in London confirm Mr. Edison's estimate of their efficiency. The result, as far as the experiments have hitherto gone, is that the dynamo machine converts into electric energy more than 90 per cent. of the power applied to turn it. Then, as to the reconversion of the current back again into work, we can also recover in a similar proportion. Of course there is a loss of energy in the electric mains, and also a loss due to leakage on the railway by imperfect insulation; but even allowing as large a margin as 50 per cent. for this, assuming that the Porter-Allen engine gives an indicated horse-power of 2½ lbs. of coal per hour, Mr. Edison finds 5 lbs. per horse-power required for his electric railway, as against six in driving a locomotive. Hence Mr. Edison thinks we may regard these figures as a reliable indication that an electric railway is a more economical means of realising the energy of coal for effecting transport from place to place. Another contrivance which Mr. Edison uses is for the purpose of enabling locomotives to clutch the rails in certain cases where the locomotive has to ascend an incline, so as to obtain a greater hold upon the rails than the simple weight of the engine supplies. In his first dynamos, Mr. Edison communicated the power by belt, but in the latter forms he has adopted an endless screw gearing, which is safer than the belt. In the dynamos which he is using to supply a current from the central station he has adopted the same method of doing away with belt and gearing, and making the engine connect to the armature of the machine, so that I think there will be still greater advances in the economy and efficiency of the machine which he has devised.

Mr. Fowler said that the assumption on which the calculations seemed to be based on the locomotive consuming 6 lbs. of coal per horse-power per hour was nearly twice the actual fact.

Prof. Forbes said that much in this paper required very great consideration before an opinion could be pronounced upon it. They were told that 90 per cent. of the power put into the dynamo was converted into electric current, but they were not told how much of that was used up in rendering the dynamo effective, *i.e.*, in overcoming the internal resistance. That statement was quite distinct from stating that 90 per cent. was being used efficiently. Perhaps about one-half might be used in overcoming internal resistance, so that if they allowed 50 per cent. for leakage and so forth, and a large loss of current in the interior of the machine, it would seem almost impossible to imagine that the cost could be so small as had just been stated.

Mr. F. J. Sprague stated that the ratio of total development of power in these dynamos was 94 or 95 per cent., and he had seen frequently machines of somewhere about 87 per cent. efficiency. He had also seen a dynamo work up to 150 horse-power.

Sir J. Hawkshaw said that they had not sufficient data before them to form conclusions in regard to the efficiency of these electric machines. He certainly did agree with the president of the section, however, in thinking that the consumption per horse-power per hour of coal in the ordinary locomotive was much overstated in these calculations.

Mr. W. Traill said that it was most interesting to hear of the progress that had been made in Menlo Park. The railway of eight or 10 miles in length there was much ahead of those in Europe. The longest on the continent was only about one and half miles. He himself was engaged with one in the North of Ireland, which, when completed, would measure about seven miles. They had not advanced sufficiently far with the railway yet to enable him to enter into details, but it promised to be a complete success. The one great point in these railways was the development of electricity from a stationary engine. In their case, however, they proposed to develop electricity by water power, which they had at immediate command. They all had the most favourable anticipations with regard to its economy.

Dr. Werner Siemens said that at Berlin they had had an electric railway in practical operation for one and a half years. In that time there had been no break down, but during the winter the loss of power on the line is more than one quarter of the power supplied. Another railway at Spandau, a little more than 4½ kilometres in length, had at places an incline of 1 in 28. About 2½ kilometres of it were on the plain. They secured in that case perfect insulation by means of suspended wires. This had worked well and economically.

Colonel Beaumont said that in connection with electric railways attention should be called forcibly to the great sources of electric energy in the water that was everywhere running to waste. He thought that the cause of electric tramways could not be helped by the use of data that were far from being correct. It had been often affirmed that engines used as much as 6 lbs. of coal per horse-power per hour; but the best locomotives of the day, developing as much as 500 horse-power would not use more than 24 lbs. per mile running at 40 miles an hour. He should think that 2½ lbs. would be about the mark, and there were engines running in this country developing a horse-power with even less than 2 lbs.—though perhaps not many. If they could have locomotives that would consume 2 lbs. an hour, there was no reason why they should take 6 lbs. as the basis of comparison. Edison's electric railway would then come to just about double the cost of the locomotive system.

Dr. Fleming said that the average locomotive had been taken and compared with the electric railway, and, under the circumstances, 6 lbs. was not an extravagant estimate. Of course, if they assumed a first-class type the basis of comparison was destroyed. With regard to the efficiency of the dynamos, something like 90 per cent. of the power employed to turn the armature was efficient. Of course the difference was accounted for in friction and waste by leakage, &c.

Mr. Fowler said that they might say generally that they had a want of materials to form an opinion on in regard to the subject before them. It was quite clear that much more was needed too before they could arrive at a definite conclusion on the subject. He must entirely demur to the last remark made, that they ought to take an average locomotive as the basis of comparison. Why should they take an absolute thing and compare it with such a development as electricity when they had infinitely better engines at work? On the contrary, they ought to compare the very best of one system with what the other system offered to them. Another point which seemed to escape the discussion was that for a locomotive engine they must use the very best and purest coal, if they had a fixed engine they could use inferior coal. Materials would no doubt be forthcoming, which were as yet lacking, for a due comparison of the cost of the two systems, and these might in some future meeting form the basis of a really valuable discussion. These questions of electric railway or compressed air were particularly interesting at the present time. He looked forward with the greatest possible interest to the accumulation of full and exact details on which trustworthy conclusions could be arrived at respecting them.

ELECTRIC LIGHT ENGINEERING.

[Paper read before Section G, 28th August, 1882, By Dr. FLEMING.]

IN view of the extensive systematising of telegraphic and telephonic systems it becomes of importance to consider whether some extended scheme may not be adopted as the means in future of effecting economy and securing safety in regard to electric lighting. The most costly item in systems of lighting in central stations will be the conducting mains. These should be so laid as to be accessible for repairs, yet out of reach of accident. Arrangements should be made by which any demand for more current should be met with the least waste. In planning any general system a system of cross bracing should be adopted, in such a manner that dependence need not be placed on one main only, but on several distinct mains in case of accident to one main, and in order to equalise the potential of the whole system. In the Edison system the conductors are inclosed in a single iron pipe, but it may ultimately prove that the better arrangement will be to lay copper bars insulated in an iron trough along the side walk, which could be laid in sections and flush with the pavement. Such an arrangement could be made watertight, and there would be great facilities both for repairs and tests. Too much stress cannot be laid on jointing. In telephone work, of course, imperfect joints are of small importance, but in a current of several ampères a bad joint may be a serious drawback. At every central station insulation tests at the circuits ought to be taken, and the faults examined and corrected. It ought to be possible to restrict the loss of leakage to 1 per cent. or less of the whole output of the current. All switches intended to break circuits should be so arranged that the current is broken at several places simultaneously. By this means sparking is reduced. Within the building every precaution should be taken that no part of the person of a visitor, workman, or loiterer should form part of the circuit. The whole of the electric conducting-wire should be under cover, though accessible. Passing to the considerations which should guide in the determination of the size of radius it is obvious that this is not a matter of indifference. The conductivity is proportional to the mass, and for unit of length proportional to the resistance. And this unit of length is universally as the cross section, hence we may easily see that there must be some section that will give a current which will be a section of greatest economy, for if the size of the copper be excessively large the waste of copper will be very great, though the waste of energy is very small. If, on the other hand, the copper be excessively small, the waste of energy would be very great. Hence there was a minimum of size for a maximum of economy, and that can be shown to be the case when the interest on the cost of the mains is equal to the actual cost of the energy wasted in them. But two factors largely determine these—price of copper and price of power. Accordingly, in places where the power is cheap, as where coal is cheap, or where water power can be secured, a very much smaller size of main conductor is necessary than in places where coal is dear or power expensively obtained. Another point with which we are concerned here is the size of the conductors, which must be taken with a view to their not overheating. The heat generated in the conductor is not wasted, but accumulates and raises the temperature, and experiment should decide the size of the wires for a particular current.

The safety catch should be so arranged that it fuses well below the strength of current at which the wires begin to feel warm. It should be borne in mind that systems which work with currents of low potential require precautions against fire just the same as those which use a high potential. No doubt it will ultimately prove necessary to have regulations to decide what is sufficient insulation. In the memorandum put forward by the fire insurance authorities the remark occurs that the main should be sufficiently insulated. Regulations are laid down for the weight of lead pipe, and its size; it must bear a given pressure of water. It ought, however, to be determined what insulation is necessary, and what is sufficient security for electric mains. One other question remains to be dealt with in conclusion, and that is the arrangements that should be made for the measurement of the light. Lighting may be carried on by contract as gas lighting, but for domestic purposes there is no doubt that lighting must be performed by means of a measured electric current. One important consideration in respect of all forms of electric meters is that they ought to be very carefully inspected, to see if they really indicate ampère-hours correctly. It is not sufficient merely to pass the same current through two meters and see if they register the same amount. The important thing to ascertain is whether the meter does register ampère-hours correctly when the two factors are greatly varied—*i.e.*, it should be seen whether a current of 100 ampères for one hour causes a meter to register the same as a current of one ampère for 100 hours. It is not possible to arrange for the correct measuring of the light when the meters vary according to the variation in the factors when thus tested.

ON THE ABSOLUTE MEASUREMENT OF ELECTRIC CURRENTS.

[Paper read before Section A, Friday, August 25th, 1882, By Lord RAYLEIGH.]

THE accurate absolute measurement of currents seems to be more difficult than that of resistance. The methods hitherto employed require either accurate measurements of the earth's horizontal intensity, or accurate measurements of coils of small radius and of many turns. If in the latter measurement we could trust to the inextensibility of the wire, as some experimenters have thought themselves able to do, the mean radius could be accurately deduced from the total length of wire and the number of turns, but actual trial has convinced me that fine wire stretches very appreciably under the tension necessary for winding a coil satisfactorily. Kohlrausch's method, in which the same current is passed through an absolute galvanometer, and through a coil suspended bifilarly in the plane of the meridian, is free from the above difficulty, but it is not easy so to arrange the proportions that the suspended coil shall be sufficiently sensitive, and the galvanometer sufficiently insensitive. In this method, as in that of the dynamometer, the calculation of the forces requires a knowledge of the moment of inertia of the suspended parts. When the electro-magnetic action is a simple attraction or repulsion, it can be determined directly by balancing it against known weights. In Mascart's recent determination a long solenoid is suspended vertically in the balance, and is acted upon by a flat co-axial coil of much larger radius, whose plane includes the lower extremity of the solenoid. This arrangement, though simple in theory, does not appear to be the one best adapted to secure precise results. It is evident that a large part of the solenoid is really ineffective, those turns which lie nearly in the plane of the flat coil being but little attracted, as well as those which lie towards the further extremity. The result, calculated from the total length of wire (even if this could be trusted), the length of the solenoid and the

number of turns, has an appearance of accuracy which is illusory unless it can be assumed that the distribution of the wire over the length is strictly uniform. It would appear that all the turns of the wire should operate as much as possible, that is, that the suspended coil should be compact, and should be placed in the position of maximum effect.

There is a further incidental advantage in this arrangement, which it is the principal object of the present note to point out. The expression for the attraction involves as factors the product of the number of turns, the square of the current, and a function of the mean radii of the two coils and of the distance between their mean planes. Now, as may be seen from the fact that the square of a current is already of the dimensions of a force, this function of three linear quantities is itself of no dimensions. In determining its actual value we should, in general, be subject to three errors, but when the position is such that the function (for two given coils) is a maximum, the result is practically dependent only upon the two mean radii, and being of no dimensions can involve them only in the form of a *ratio*. In order then to calculate the result, all that it is necessary to know with precision is the ratio of the mean radii of the two coils. This ratio can be obtained electrically with full precision, and without any linear measurements. For if the two coils, considered as galvanometer coils, are brought co-axially into the same plane, the ratio of their constants can be found by the known method of dividing a current between them in such a way that no effect is produced upon a small magnet suspended at the common centre. The ratio of the resistances in multiple arc gives the ratio of the currents, and this again, subject to small corrections for the finite size of the sections, gives the ratio of the mean radii.

It appears that in this way all that is necessary for the absolute determination of currents can be obtained without measurements of length or of moments of inertia, or even of absolute angles of deflection. In practice it will be desirable to duplicate the fixed coil, placing the suspended coil midway between two similar fixed ones through which the current passes in opposite directions. A rough approximation for the condition of things above described will be quite sufficient.

EQUILIBRIUM OF LIQUID CONDUCTING MASSES CHARGED WITH ELECTRICITY.

[Communicated by LORD RAYLEIGH to Section A, Friday, 25th Aug.]

IN consequence of electrical repulsion a charged spherical mass of liquid unacted on by other forces is in a condition of unstable equilibrium. If a_0 be the radius of the sphere, Q the charge of electricity, the original potential is given by

$$V = \frac{Q}{a_0}$$

If, however, the mass be slightly deformed, so that the polar equation of its surface expressed by Laplace's series becomes —

$$r = a(1 + F_1 + F_2 + \ldots + F_n + \ldots)$$

then

$$V = \frac{Q}{a_0}\left\{1 - \Sigma(n-1)\iint \frac{F_n^2 d\sigma}{4\pi}\right\}$$

and the potential energy of the system reckoned from the equilibrium position is—

$$P^1 = -\frac{Q^2}{8\pi a_0}\Sigma(n-1)\iint F_n^2 d\sigma$$

In actual liquids this instability indicated by the negative value of P^1 is opposed by stability due to the capillary force. If T be the cohesive tension, the potential energy of cohesion is given by—

$$P = \tfrac{1}{2}a_0^2 T\, \Sigma(n-1)(n+2)\iint F_n^2 d\sigma^*.$$

If $F_n \propto \cos(pt + \epsilon)$ we have for the motion under the operation of both set of forces—

$$p^2 = \frac{n(n-1)}{\rho a_0^3}\left\{(n+2)T - \frac{1}{4\pi}\frac{Q^2}{a_0^3}\right\}.$$

If $T > \frac{Q^2}{16\pi a_0^3}$, the spherical form is stable for all displacements. When Q is great the spherical form is unstable for all values of n below a certain limit, the maximum unstability corresponding to a great but still finite value of n. Under these circumstances the liquid is thrown out in fine jets, whose fineness, however, has a limit.

The case of a cylinder, subject to displacement in two dimensions only, may be treated in like manner.

The equation of the contour being in Fourier's series—

$$r = a(1 + F_1 + \ldots + F_n + \ldots),$$

we find as the expression for the potential energy of unit length—

$$P' = -\frac{Q^2}{l^2}\Sigma(n-1)\int \frac{F_n^2 d\theta}{2\pi},$$

Q being the quantity of electricity resident on length l.

The potential energy due to capillarity is

$$P = \tfrac{1}{2}\pi a T\, \Sigma(n^2-1)\int \frac{F_n^2 d\theta}{2\pi}$$

* See Proc. Roy. Soc., May 15th, 1879.

and for the vibration of type, n, under the operation of both sets of forces—

$$p^2 = \frac{n^2 - n}{\rho a^3}\left\{(n+1)T - \frac{2Q^2}{\pi l^2 a}\right\}.$$

The influence of electrical charge in diminishing the stability of a cylinder for transverse disturbances may be readily illustrated by causing a jet of water from an elliptical aperture to pass along the axis of an insulated conducter tube, which is placed in connection with an electrical machine. The jet is marked with a recurrent pattern, fixed in space, whose wave-length represents the distance travelled by the water in the time of one vibration of type, $n = 2$. When the machine is worked the pattern is thrust outwards along the jet, indicating a prolongation of the time of transverse vibration. The inductor should be placed no further from the nozzle than is necessary to prevent the passage of sparks, and must be short enough to allow the issue of the jet before its resolution into drops.

The value of T being known (81 C.G.S.), we may calculate what electrification is necessary to render a small rain-drop of, say, 1 millimetre diameter unstable. The potential expressed in electrostatic measure is given by—

$$V = \frac{Q}{a_0} = \sqrt{(16\pi a_0 T)} = 20$$

The electromotive force of a Daniell cell is about ·004, so that an electrification of about 5,000 cells would cause a division of the drop in question.

ON THE DURATION OF FREE ELECTRIC CURRENTS IN AN INFINITE CONDUCTING CYLINDER.

[Communicated to Section A, Friday, 28th August, 1882, by LORD RAYLEIGH.]

TAKING the axis of the cylinder as that of z, we suppose that the currents are functions of—

$$\sqrt{x^2 + y^2}$$

or r only, and flow in the circles r = constant.

From the equations given by Maxwell's "Electricity," Vol. II., § 591, 598, 607, 610, 611, we may deduce for a conductor of constant, μ—

$$\left(\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)c = 4\pi\mu C\frac{dc}{dt}$$

with similar equations for b and a.

In the present case the magnetic forces b and a vanish, and c is a function of r only. Thus—

$$\left(\frac{d^2}{dr^2} + \frac{1}{r}\frac{d}{dr}\right)c = 4\pi\mu C\frac{dc}{dt}$$

or if c and e^{nt}

$$\left(\frac{d^2}{dr^2} + \frac{1}{r}\frac{d}{dr} + 4\pi\mu n\cdot C\right)c = 0$$

the solution of which, subject to the condition of finiteness at the centre is—

$$c = A\,J_0\left(\sqrt{4\pi\mu n C}\cdot r\right)$$

To determine the admissible values of n we have only to form the condition which must be satisfied at the boundary of the cylinder, $r = R$. It is evident that the magnetic force must here be zero, and for that the condition is—

$$J_0\left(\sqrt{4\pi\mu n C}\cdot R\right) = 0$$

The roots of the functions are 2·404, 5·520, 8·654, 11·792, &c. For the principal mode of longest duration—

$$C = A\,J_0(2\cdot4042 \mid R)$$

and

$$n = \frac{2\cdot404^2}{4\pi\mu C R^2}$$

If τ be the time in which the amplitude sinks in ratio $e : 1$—

$$\tau = \frac{1}{n} = \frac{4\pi\mu C R^2}{2\cdot404^2}$$

For copper in C.G.S. measure—

$$C = \frac{1}{1642},\ \mu = 1, \text{ and then } \tau = \frac{R^2}{800} \text{ nearly.}$$

In order that τ should be one second, the diameter of the cylinder would have to be about two feet.

ELECTRIC LIGHTING AT GODALMING.—It is anticipated that a considerable extension will shortly take place in the electric lighting of this town, that at present in operation having proved highly satisfactory. The water-motor, we hear, has been abandoned, as the water supply was not to be depended on.

BROOKS' UNDERGROUND CABLE SYSTEM.

CONSIDERABLE progress is likely to be made with this system in America owing to the success which has attended the lengths of line already in use, in fact several contracts have already been agreed upon for the laying down of numerous wires on the principle.

Two years ago about 5 miles of the Brooks cable was laid between Jersey City and Newark, this cable crossed the Hackensack and Passaic, and the intervening salt marsh. There were seven test boxes on the route and as many reservoirs of oil. Owing to defects in construction this line did not prove a success, and it was subsequently replaced by a new cable; the latter has but one reservoir instead of seven as on the old line; this reservoir is situated three miles distant from Jersey City at an elevation of 25 ft. above the cable house at the latter place. The insulation resistance of the wires averages from 10 to 15 megohms per mile, an insulation amply sufficient for all practical purposes.

Soon after the completion of the line two of the conductors, which in the first instance were testing well, became damaged by lightning and showed almost full earth, and subsequently the other wires became defective from the same cause. At the time these faults occurred the ends of the cable were unprovided with lightning protectors, but the latter were afterwards fitted. It was at first thought that the faults were caused by the pipe in which the wires were enclosed becoming broken, but as this proved not to be the case a few gallons of the insulating oil were allowed to flow through the pipe, and this caused the faults to gradually disappear, so that all the wires were rendered workable.

Since the lightning protectors (plate) were fixed in position, some of the plates have been fused together by the violence of the discharges, and the papers of every set of plates have been perforated; this shows that the faults which developed in the wires previous to the placing of the protectors were probably severe ones. The possibility of removing lightning faults in the wires is a peculiar and most valuable feature of the Brooks system.

For telephonic purposes the Brooks cable seems eminently adapted, as with a metallic circuit formed from two wires no appreciable inductive disturbance is found to exist, even where very heavy working currents are being transmitted through the adjacent wires in the same pipe.

We believe that the line of 30 conductors, on the Brooks system, laid several months ago between Waterloo and Clapham Junction, on the London and South-Western railway, continues to work most satisfactorily, and has given no trouble whatever. No doubt, should the postal authorities at any future time contemplate constructing a new trunk line, to meet the increasing requirements of the service, the advisability of adopting the Brooks system will be seriously considered, more especially when the comparatively low cost of the invention is borne in mind.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

INDIVIDUAL TELEPHONIC CALL BELLS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Having noticed from time to time various accounts of individual call bells for telephone exchanges published in your journal, and having had some experience with such bells in the United States, I take the liberty of offering a few remarks upon that subject. There are something over [illegible] telephone exchanges, and in the neighbourhood of [illegible] subscribers connected to these exchanges, now in [illegible]ited States. I think I may safely say that about one [illegible] these exchanges have had some experience in the use of individual calling systems. When I say individual calling systems, I mean an exchange system by which a number of subscribers may be looped in on the same circuit wire, and not only have secrecy of communication with the central office, but never have their bell rung except when they are wanted.

There have been a vast number of inventions made in this country for the purpose of accomplishing this end, and they have all succeeded more or less well. These bells have not, however, been universally adopted by the telephone companies. The inventors would, undoubtedly, say this failure was due to the subscribers, and not the fault of the bells; and I must agree with both managers and inventors, that if our subscribers were only well educated mechanics and electricians, and were as patient as cultivated persons should be, why then an individual call-bell system would be both an economical and temper-saving invention. But in the present ignorant state of the human race in general, the simpler the construction, and, therefore, the operating of a telephone exchange, the more likely it is to be financially successful.

More than half the calls received now by central offices are given by impatient people who want instantaneous communication with some other subscriber, and there is nothing so annoying to such a person as to go to his telephone and find the wire in use, and this often happens upon circuit wires of four or six stations.

As the telephone becomes more and more a necessity to a business man so the more does he make use of it for the transmission of important messages, and he requires great promptness and precision in its working. And it is my experience, and I may say that of nearly all persons connected with the telephones of this country, that the exchanges are gradually changing their circuit wires of a number of stations for direct wires; and this is not wholly due to the imperfection of the bells, but to the fact, as I say, that subscribers are gradually getting to use their telephones for saving minutes and seconds instead of mere playthings. They are more willing to pay a higher rental, provided they can get more efficient service, and such service can only be rendered by a direct wire system. The reasons are obvious. In the first place, the chance of a telephone getting out of order increases directly as the number of stations on the same circuit wire. Secondly, on circuits of a large number of stations the chance of delay on account of the wires being in use is very much greater than in the case of a direct wire. Thirdly, it takes much longer to call and make connections where an individual bell circuit system is employed than in the case of a direct wire system.

It is, however, undoubtedly necessary for most small exchanges—especially those in small country towns—to make use of some form of circuit wire system to a limited extent, on account of the long distances wires have to be run to reach subscribers and the low rates such exchanges are obliged to use; but even in such cases I cannot recommend the use of the individual bell. I believe it is better to limit the number of stations to four that are looped in on the same wire and construct the circuit as simply as possible, using only the magneto, or whatever call bell the exchange may think best, and call by numbers. I fix the limit of stations to four because I do not think that more than that number can be connected without there being danger of subscribers interfering with each other, as they generally want to use their instruments at the same time of day. In America the magneto generator is being universally adopted in place of all other forms of calling apparatus, and some of our best exchanges are using this bell alone upon their circuit lines — calling, as I stated above, by striking the number of the station. I fully appreciate the ingenious inventions of Anders', Bott, Stabler, Brown and Saunders, and Bliss. A circuit thirty-three miles in extent, connecting twelve stations upon which the Bliss individual bell is used, has been constructed for the Croton Aqueduct Company of New York City. This circuit works well, but it must be remembered that it is only used by civil engineers and mechanics, and is only a private line for communication between the offices of the company, so that the chances of its getting out of order are small as compared with our ordinary exchange circuit. Yet, judging from what I have seen of the working of this circuit since its construction, I should say that it was out of order about twelve times as

often as a direct wire exchange connection, or just as many times oftener as there are stations upon the line. In regard to the cost of construction of a direct wire system, of course it is greater than a circuit wire; but, on the other hand, the maintenance is less, and the rates should be regulated according to the distance the subscriber's station is from the exchange central office, and also as to the amount of pole construction necessary in order to make the connection. It is so strong a conviction in the minds of some telephone companies, that circuit wires are not economical, that they decline to build such lines. What I have endeavoured to explain to you is, in short, that, although an individual bell in the hands of competent operators may be in some cases a valuable addition to a telephone circuit, yet I think that experience has shown that, no matter how perfect a machine it may be in the hands of the average subscriber, impatient at every little delay and perfectly ignorant of the instrument he is using, it is not of sufficient practical and economical value to warrant its general use by a telephone exchange.

I remain, Gentlemen,
Your obedient servant,
WILLIAM R. CABOT.

Yonkers, New York, *August 30th*, 1882.

CARBON LIGHTNING PROTECTORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—As paragraphs respecting the resistance of carbon being lowered when heated have appeared—since my letter of 26th August—in the ELECTRICAL REVIEW of the 9th and of the 23rd inst., and the subject is, therefore, still before your readers, I shall be glad, if you will allow me, to ask why the powdered carbon in lightning protectors is at times formed by lightning into a conducting mass. Many cases have come under my notice where the carbon after lightning has become so good a conductor as to form a connection between the line and earth wires, and has thus short-circuited the instruments. A slight tap with a hammer on the wooden portion of the protector is sufficient to separate the mass and set the fault right. Are the powdered carbon transmitters in connection with telephones similarly affected?

I am, Sirs, Yours faithfully,
F. T. J. HAYNES.

Taunton, *September 23rd*, 1882.

[Mr. Varley would probably like to reply to our correspondent's questions on these points, and we feel sure that an explanation from his pen would be most welcome to our readers.—EDS. ELEC. REV.]

THE TELEPHONE.

53, BERNARD STREET,
RUSSELL SQUARE, W.C., LONDON,

JAMES BRAND, ESQ.,
Chairman of the United Telephone Company (Limited).

DEAR SIR,—I have the pleasure to give you notice that I am having made and am selling telephones constructed under Patent 2419, of 1880, Lockwood and Bartlett. I refer you also to my advertisement in the ELECTRICAL REVIEW of the 16th inst., and following Saturdays. I also enclose a circular issued by my manufacturers.

In this telephone "a plate capable of inductive action" is not used, but "a tongue," as in the Reis instrument of 1862, which instrument, Mr. Justice Fry, after hearing the evidence of the witnesses on the part of your company, and the able arguments of the eminent barrister, Mr. Aston, your counsel, decided not to be like unto Bell's instrument, for if it were then Bell's patent would be void because of the prior publication of Reis's instrument in England.

Considering the course heretofore pursued by your company in regard to other inventions, I hereby inform you that I shall take legal proceedings without delay against any and all persons who shall presume to attempt to injure my prospects in the above-named patent, by stating it to be an infringement of Bell's or of any other patent.

Respectfully,
Your obedient servant,
September 26th, 1882. W. C. BARNEY.

[A copy of the above self-explanatory letter has been forwarded to us by Mr. Barney for publication in our columns, together with the circular of Messrs. J. T. Gent & Co., of Leicester, who are manufacturing the instruments referred to. It is not necessary to deal with the latter, as it simply gives the list of the low prices at which these telephonic instruments are supplied, and the opinion amongst others of Mr. C. F. Varley, who states that the Lockwood & Bartlett Telephone does not infringe the patents of Edison or Bell.—EDS. ELEC. REV.]

THE GÜLCHER ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I observe that in your notice of the electric lights at the North-East Coast Exhibition, you write:—"But when one arc lamp gives out a superior light to others, the chances are that it is consuming proportionately more horse-power." I think this is calculated to give the public an impression that our light does consume proportionately more horse-power; and as, on the contrary, our system has the advantage of giving a greater candle-power in proportion to the horse-power employed, I shall be very much obliged if you will let this appear in your next publication.

I am, dear Sirs,
Yours faithfully,
C. H. CHARLEWOOD,
Secretary.

121, Bishopsgate Street Within, London,
Sept. 27th, 1882.

[We insert Mr. Charlewood's letter with pleasure. What we intended to convey in our remarks was that if a given current strength is passed through the carbons of electric lamps, the same light-power may be obtained in various lamps, provided that the carbons employed are of the same kind, and the resistance of the coils in the lamps are alike.—EDS. ELEC. REV.]

NEW DYNAMO-ELECTRIC MACHINES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In reference to your remark in your last issue with regard to the efficiency of the Ferranti machine, I take the liberty of drawing your attention to the following extract from an article in the *Engineer* of Saturday last. I take the opportunity of explaining that in speaking of the Ferranti machine as five times as efficient as any other dynamo machine, I had reference to the first standard, and not the second.—Yours truly,

ROBT. HAMMOND.

110, Cannon Street, London, E.C., *Sept. 27th*, 1882.

[EXTRACT.]

"There are two distinct primary standards by which the efficiency of a dynamo can be measured, and we would impress on our readers the necessity of keeping these standards carefully apart. According to the first the efficiency of the dynamo is determined by its small size, low first cost, and excellence of construction in the matter of workmanship. According to the second, its efficiency is measured by the proportion which the power given out bears to that put in."

ROBBERY OF TELEGRAPH MATERIAL.—The foreman to Messrs. Fitzmaurice & Co., the Birmingham contractors for keeping the underground telegraph wires in order, and an assistant were, at Birmingham this week, charged with stealing a quantity of telegraph wire belonging to the Post-office authorities. It was stated that owing to the robbery all communication with the North was suspended for upwards of two hours, and a great number of wires could not be completely rectified for two days. The men were engaged in connection with a number of wires running in one direction when they came upon several running across, and pulled them up with the assistance of two horses. The sudden interruption at the telegraph offices caused the authorities to think some very serious accident had occurred. It was eventually found that the prisoners had sold the wire to a marine store dealer. One of the wires which the men broke and sold was rented as a private wire by a London and Manchester firm of cotton brokers. The Stipendiary Magistrate committed the prisoners for trial.

ELECTRO-MOTORS.

LAST week, when describing the "Griscom" electro-motor, we challenged the accuracy of the inventor's statement concerning the effect of the currents induced in the wire with which the ring of the motor is coiled, by the action of the revolving armature. Our assertion that the induced current is in opposition to the battery current has had the effect of bringing us into direct communication with Mr. Heap, the representative of Mr. Griscom's invention in this country. The gentleman referred to maintains that the induced current strengthens the battery current, and, in the endeavour to prove his views, he has very courteously

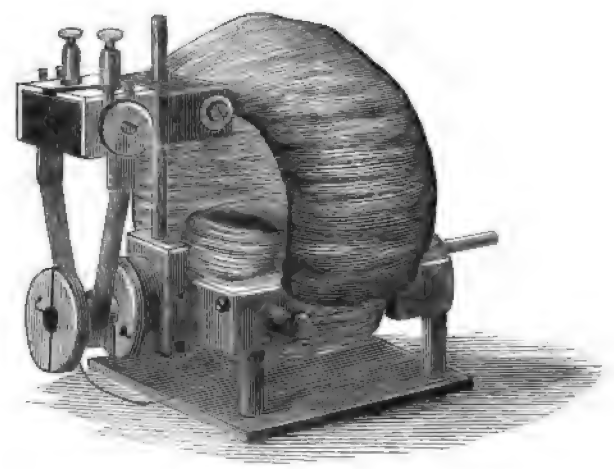

FIG. 1.

allowed us to make use of a model motor, constructed specially to show the effect of "double induction." A general view of the apparatus is shown in fig. 1, and a diagram is given in fig. 2. The motor consists of an ordinary Siemens armature, A, revolving between the ends of a soft iron horse-shoe, I. This latter is coiled with wire, W, and

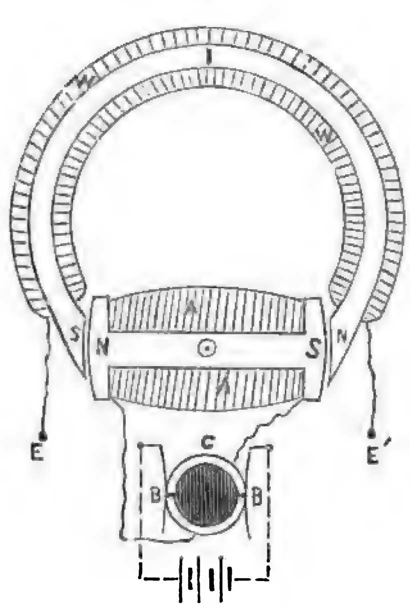

FIG. 2.

the ends, E, E′, may be left free or they may be connected together, forming a closed circuit round the horse-shoe. The commutator, C, is of the ordinary construction, and the rubbers, B, B, are made in the form of the "Gramme" brushes. These may be adjusted at any point on the commutator, being movable on a centre, as can be seen in fig. 1. This model motor will revolve in either direction by shifting the brushes more to the left or to the right. If a battery be connected to the brushes, as shown in the diagram, and the armature magnetised, attraction immediately ensues between the poles and the ends of the soft iron horse-shoe—the ends, E, E′, of the coil, W, being left quite free—and the armature begins rapidly to revolve. Now if the ends, E, E′, be joined together, forming a closed circuit round the horse-shoe, the armature increases its pace in a great degree.

Mr. Heap holds that this model, although different in construction, is identical in principle to the present form of the Griscom electro-motor, and that the extra speed given to the armature on closing the circuit of the coil, W, proves that the induced current adds to the power of the battery current.

It will be observed that the battery is not attached in any way to the coil surrounding the soft iron. By means of the diagram, fig. 3, we hope to be able to place before Mr. Heap an exact representation of what occurs in the foregoing model when the coil around the soft iron is open or closed. We will suppose N, S, to be two magnetic poles, an equivalent in fact of the Siemens armature; I, again, represents the soft iron horse-shoe straightened out, and W is the coil surrounding it. Now if we pass before the ends of the soft iron the poles,

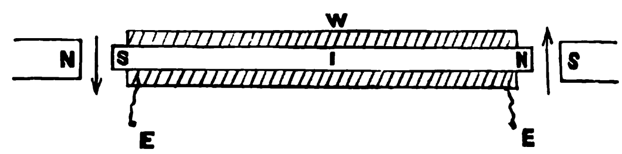

FIG. 3.

N, S, in the direction of the arrows we shall meet with a certain resistance to motion owing to the magnetic attraction set up between the masses. As long as the two ends of the coil, E, E′, are kept apart we may regard I in the light of soft iron only; but directly they are joined we must look upon it from another point of view. It now becomes magnetically acted upon from two different sources; magnetism due to the inductive action of a magnet in its vicinity, and magnetism induced from the current set up in the closed circuit of the coil, W. This induced current tends to magnetise the iron in an *opposite* direction to that due to the induction of the magnet, the resultant magnetism being, therefore, weaker than in the first case, when the coil, W, is open. It is, therefore, easy to understand that the resistance to motion will now be less, and therefore the same amount of energy developed by the battery will drive the armature round at a faster speed. It should be recollected that increased velocity does not necessarily mean increase of power. According to the

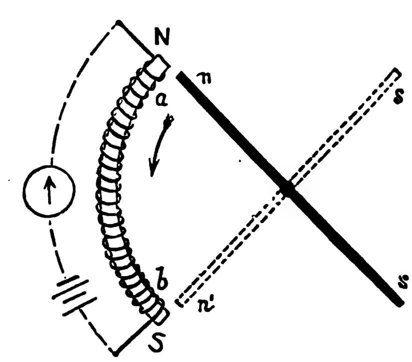

FIG. 4.

Griscom theory we might argue that the power required to move a railway train at a velocity of twenty miles an hour with the brakes off is greater than that necessary to propel it at a speed of ten miles an hour with the brakes hard on, simply because the velocity in the one case is greater than that in the other. We think that this explanation will make it sufficiently clear to show where Mr. Heap is in error, and in order to still further maintain our statements of last week we will return to the subject of the Griscom motor proper.

We will consider what takes place in this electro-motor by regarding the coiled portion of the ring as a segment of a "Gramme" ring, the ring being stationary and the field magnet rotating. The current in the ring-wire will then be continuous as long as the wire remains under the action of

the field magnet. In this question we have nothing to do with the magnetism of the ring, but only with the magnetism of the field magnet acting upon the coiled segment of the ring, in which it produces, as we have said before, a current in a contrary direction to the battery current.

Take a helix, a, b (fig. 4), surrounding a segment of iron and pivot in front of it the magnet n, s. Now, if a battery and galvanometer be put in circuit, it will be found that the magnet, n, s, will be deflected to n', s', the galvanometer at the same time showing a deflection. Then remove the battery (fig. 5), and move by hand the magnet, n, s, into the position, n', s', and a deflection on the galvanometer in the *opposite* direction to that due to the battery in the previous experiment will be observed, and not in the same direction. The magnet represents the magnetised rotating armature, and the helix the stationary coil in Griscom's motor. With these two different explanations of the action of the American inventor's apparatus, we think that sufficient proof has been put forward that the induced current is in the reverse direction to that produced by the battery. Indeed, could

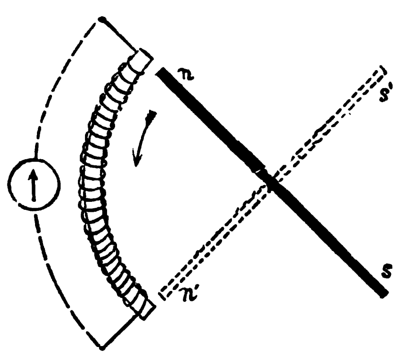

FIG. 5.

Mr. Griscom support his theory, he would have made a promising step in the direction of the much-coveted *perpetuum mobile*.

However we have seen this little instrument performing various operations, and it appears to be a highly satisfactory apparatus for many purposes. For sewing machines it is especially to be recommended, and we have seen a double thickness of cloth very rapidly sewn together, the current being produced by a battery similar to that we described last week and containing six elements. When we called upon Mr. Heap, this battery had already been in action about five weeks, and he informs us that sewing machines might be used for the ordinary work of a private house every day for two months or so, without any necessity arising for recharging the battery. Two of these motors with their axles joined together, and connected electrically in multiple arc, are calculated to produce the power of one man, when actuated by the battery just alluded to. We think that such an admirable domestic help as the Griscom motor would command ready appreciation were its performances made more publicly manifest.

NOTES.

ERRATUM.—In our article on the Jürgensen dynamo-electric machine and lamp last week, p. 239, for "21 lights of 2,000 candle-power," read, "4 lights of 2,000 candle-power."

NEW DYNAMO-ELECTRIC MACHINES.—We have been informed that 40 arc lamps (candle-power not stated) have been kept alight from the new Ferranti-Thomson machine, all being connected in multiple arc. We also further understand that the patents of the two inventors include both alternating and continuous current machines, based on the same principle.

THE MAXIM-WESTON ELECTRIC LIGHT COMPANY.—Mr. Frank Howard Landon writes to us to the effect that he has resigned the secretaryship of the above company.

THE ELECTRIC LIGHT ON THE S.S. "INVICTA."—It may interest our readers to know that the fitting up of the lights on board the *Invicta*, which has been referred to in various papers as being very successful, was entirely carried out by Messrs Siemens Brothers; although, up to the present, we believe, the name of that well-known firm has not been mentioned in connection with the installation. We understand that Messrs. Siemens have lately obtained the contract for fitting out the S.S. *Arizona* of the Guion Line, entirely with the electric light.

ELECTRIC LIGHTING.—A special meeting of the Manchester city council has been called for Wednesday, October 25th, for the purpose of adopting, if the council shall think fit, a resolution or resolutions, authorising and directing an application to the Board of Trade for a provisional order, empowering the Corporation to supply electricity for public and private purposes, within an area co-extensive with the city of Manchester, and authorising the Town Clerk to take all steps prescribed by law for the promotion of such application.

A VERY successful experiment was made last week with the electric light at Grandholm, near Aberdeen. The new dye house, a building 170 ft. by 40 ft., was well lighted by three Fyfe-Main lamps. Two large steam pipes from the engine house boiler were used to fill the building with steam to its utmost capacity. No appreciable difference was noticed either in the illumination or the steadiness of the light. Samples of woollen materials of a variety of colours and shades were compared, and they could be distinguished as well as in daylight.

A SPECIAL meeting of the Sheffield Town Council was held on Wednesday week, to consider what action they should take under the Electric Lighting Act. Six electric lighting companies in London and elsewhere had given notice to the Council of their intention to apply for a provisional order, and it was the wish of a very large majority of the Council that they should be prevented from coming to the town. After a long discussion, it was decided that it was desirable that the Council should apply to the Board of Trade for a provisional order, and a committee was appointed to take the necessary steps to obtain it.

WE understand that at a meeting of the Glasgow Gas Committee on the 20th inst., the position of the city with reference to several electric light companies was duly considered. It was unanimously resolved to recommend the Council to apply for a provisional order enabling the Corporation to light the streets by means of electricity should such a step be considered desirable.

THE Maxwelltown Town Council has transmitted the electric light companies' applications to the Clerk of Commissioners of Police for consideration.

A STATISTICIAN says there are already thirty electric light companies in England, with a capital of over £6,000,000. The number in France is less, but the capital is nearly as great. There are over fifty companies in America, and the capital is considerably over £10,000,000. The average dividend is not given.

AT the periodic meeting of the Edinburgh Town Council, on Tuesday, notice was given of the following motion:—"That in view of the numerous intimations by speculative companies of intentions of applying to the Board of Trade and to Parliament for authority to introduce the electric light into the city it be remitted to the Lord Provost's committee to consider whether the council does not already itself possess that power; and if it does not, whether any supplementary powers necessary should not be sought under the Electric Lighting Act of the present session of Parliament."

THE Railway Electric Appliances Company have made the following proposal to the Glasgow Town Council:—"That the City of Glasgow should go to the expense of erecting electric lamp standards in each of the four large plots in George Square, as well as running the necessary copper leads for lighting the lamps. The Appliances Company then undertaking to put their lamps up for a certain time, receiving payment or not at the option of the Corporation. The advantages of this system would be that the Corporation would have the power of viewing the various

methods tested at very little expense; that they could say to each company desiring to compete for the city lighting: 'Here are our four standards, put your lights up and run them for a month free.' After the Corporation had tried several of the most improved systems they would then be in a position, having the prices and terms before them, to decide which to adopt." This communication and the general question of lighting the streets by electricity were remitted to a committee for consideration.

THE Swan, Edison, Crompton, and other companies, have given notice of their intention to apply to the Board of Trade for Provisional Orders to supply Glasgow with electricity.

IN a section of the London Underground Railway it is proposed to fix, experimentally, some 200 Swan incandescent lamps, so as to do away with the artificial lighting of the carriages.

ELECTRIC LIGHTING STANDARDS.—The following letter, which appeared in the *Times*, refers to the respective merits of two differents systems of electric lighting :—

1, Great Winchester Street Buildings, *Sept. 26th.*

Sir,—My attention has been drawn to a statement in the advertised prospectus of the Lancashire Maxim-Weston Electric Lighting Company (Limited), on the authority of Mr. W. Sugg, of gas-burner celebrity, that the "Jablochkoff light" is equal to 114 candle-power as compared to a much larger illuminating power said to be given by the "Weston and other arc" lamps. The Jablochkoff light has been tested by the scientific staff of the Metropolitan Board of Works in connection with the lighting of the Victoria Embankment. The experiments extended over ten days, and the average lighting power of the lamps there was proved to be equal to 378 candles, and as such reported to the Metropolitan Board of Works.

As the statement made in the prospectus above referred to is calculated to seriously prejudice this company, I beg you will allow me to make this correction, and at the same time to state that although we have adopted this as our standard, the Jablochkoff light is capable of a much greater illuminating power by using larger candles.

I am, Sir, yours truly,
FRA. B. REEVES, Secretary of the Jablochkoff Electric Light and Power Company (Limited).

We do not think that the Jablochkoff Company will suffer by such remarks as those of Mr. Sugg, who does *not* state what *extra* horse-power is taken up in the Weston Arc Lamp to account for its superior light.

ELECTRIC LIGHTING IN THE CITY.—At the meeting of the City Commissioners of Sewers this week a report was submitted by Mr. Baylis, giving an analysis of the provisions of the Electric Lighting Act, 1882. The Clerk laid before the Court notices under the Electric Lighting Act from the Edison, Metropolitan Brush, Pilsen-Joel and General, Swan United, and Gülcher Electric Light Companies, and Messrs. Ferranti, Thompson, and Ince, of their intention to apply to the Board of Trade for provisional orders to supply electricity within the City. The notices were referred to the Streets Committee.

THE UNIVERSAL ELECTRIC COMPANY (LIMITED).—The following report of Professor S. Thompson will probably interest our readers, but we can scarcely understand the apparently low efficiency of the lamps, both arc and incandescent :—

GENTLEMEN,—I have the honour of presenting you with a preliminary report upon the machines and appliances of the Universal Electric Company (Limited). I have devoted two days to examining and testing the same, with very satisfactory results.

The machines and instruments that have been examined by me are of five kinds:—

1. The Akester Dynamo-electric Generator.
2. The Akester Arc Lamp.
3. The Akester Incandescent Lamp.
4. The Akester Motor.
5. The Mercurial Exhausting Pump for procuring the vacuum in the lamps.

The Akester Dynamo is of great excellence. As an electrical generator its efficiency is very high, as is witnessed both by careful tests and by the fact that the armature-coils are not sensibly heated after running for several hours continuously. It is extremely simple and workmanlike, both in design and construction, and has the great advantage of requiring little skilled labour in its manufacture. Its electromotive force, while ample both for arc lights and incandescent lamps, is below 100 volts even when running at its highest speed; and it is, therefore, impossible for any danger to ensue from any person touching any part of the machine.

The Akester Arc Lamp is of an entirely novel construction. The regulating mechanism, usually so complicated and expensive in lamps of this class, is extremely simple, and at the same time serves efficiently the function of regulating the arc and feeding the carbon as fast as consumed. The arc lights examined by me possessed a brilliancy exceeding 500 candles per electrical horse-power.

The Akester Incandescent Lamp is well made, and stands satisfactorily the tests I have applied as to its illuminating power. The lamp nominally of 12½ candle-power gave an actual light of 21 candles, with a current of 1½ ampères.

The Mercurial Exhausting Pumps employed on the Works are cheap and practical in every way.

The Akester Electric Motor having a power of about 1-10th of a horse-power runs extremely well, and is a handy and portable motor. It is superior to the motors of Griscom, Trouvé, and others, in having no dead points. It would be extremely useful for driving lathes or other light machinery.

Your works appear to be most admirably suited for the purpose of an electric manufacturing establishment, and I cannot speak too highly of the attention and kindness of Mr. Akester and his subordinates in affording me every kind of facility for making the tests and for examining the work in hand.

I am, Gentlemen,
Your obedient servant,
SILVANUS P. THOMPSON.

4, Baltic Street, Glasgow, *September 26th*, 1882.

We hear that this company has already received sufficient orders to keep it supplied with work for a considerable time.

RAILWAY AND ELECTRIC APPLIANCES COMPANY.—His Grace the Duke of Manchester, K.P. (chairman of the Railway and Electric Appliances Company, Limited), visited Glasgow last week, for the purpose of inspecting the works of the company at Polmadie, as also the extensions now being erected there. His Grace was accompanied by the Hon. the Lord Provost, and a number of other gentlemen. They were conducted over the works by the manager, and the various electrical appliances were fully explained and demonstrated by the inventor (Mr. Rankine Kennedy). The Maxim lamp was exhibited, over 100 of them being lighted by a small Kennedy dynamo machine. Four Kennedy arc lamps of 2,000 candle-power were also exhibited, supplied by a similar machine. The great power and steadiness of these lamps were admired, and his grace expressed himself as highly satisfied with all he had seen. The company, it may be added, has at present a considerable number of orders on hand to light private mansions.

We extract some correspondence from the columns of the *Daily Mail* concerning the operations of this company :—

In reply to a "Shareholder's" question in his letter appearing in this morning's *Mail*, you will perhaps allow me to explain that the dynamo machines and electric arc lamps which were exhibited at the Crystal Palace, and obtained the silver medal there, and from which such splendid results were obtained on Wednesday last, were constructed according to my patent, obtained by me in the beginning of October, 1881. Mr. Akester applied for a patent for a dynamo-electric machine in the end of December, 1881, after having easy access to our works for two months, during which we were manufacturing machines according to my October patents. For obvious reasons I lodged an opposition to the granting of his petition for a patent, and on the case coming before the Attorney-General, he did not "declare that the patent was Mr. Akester's," but merely gave Mr. Akester permission to apply for the sealing of his patent; and if Mr. Akester should apply for the seal, I can have the case heard in open court, and witnesses produced on oath to show reason why the seal should not be granted for the patent which he applied for in December last. The dynamo-electric machine involved in the opposition is the dynamo-electric machine for which Mr. Akester applied for a patent in December. The opposition had nothing to do with my patent, which was obtained in October, three months before Mr. Akester's application. This explanation will clear up some of the mistakes into which "Shareholder" has fallen. I can take no further notice of anonymous letters.—I am, &c.,

Glasgow, *Sept. 23rd.* RANKIN KENNEDY.

In sympathy with your correspondents, "Lynx" and "Fly-catcher," I should like to get some information about this company. From a paragraph which appeared in the ELECTRICAL REVIEW of Saturday, the 16th inst., it appears that from the statutory return made by the proper official of the company, and filed on the 22nd ult., "the nominal capital of the company is £500,000, in £1 shares. Upon 91,668 shares 12s. 6d. has been called up, and 12,000 shares have been issued as fully paid-up. The total amount of calls paid is £33,144 4s., which includes £1,499 paid in advance of calls due on August 25th. The total amount of calls unpaid is £24,148 6s." From the prospectus of the company it appears that the vendors, viz., "The Williams Railway Patents Company (Limited)," and "The National Electric Company (Limited)," were to receive £95,000 in cash and paid-up shares. Perhaps Messrs. Smith and Arrol, who were directors of both companies, will inform the shareholders whether the enormous sum has been paid, and if so, for what? It would be well that a statement full and clear were given, and particularly to whom the 12,000 paid-up shares were given, and for what? There is quite sufficient in the public records to afford information for making a precise analysis of this company and the work it has done for the last six months.—I am, &c.,

Glasgow, 26*th Sept.* ANOTHER SHAREHOL-

FIRE RISKS FROM ELECTRIC LIGHTING.—Mr. Heaphy, C.E., in a letter to the *Times*, adds still further to the rules and regulations recently framed by him for the guidance of the Phœnix Fire Office, but these additions are addressed more directly to the occupiers and owners of private dwellings.

Rule 1.—See that no naked wires are used. Try and arrange that they be covered with a material rendered as incombustible as possible. This you can very easily test for yourself.

Rule 2.—See that all wires are kept at least one inch apart from each other (if they are "leads" two inches), and one inch from all metallic substances.

Rule 3.—See that no wire hangs loosely, and that they are in such a position as not to be liable to derangement or injury from external causes. Get them enclosed, if possible, in wood or slate beading having a continuous fillet to keep the wires separate.

Rule 4.—See that none of the fastenings of the wires are composed of metal.

Rule 5.—Have a "cut out" for every room, and if possible for every light. A "cut out" is a short piece of easily fusible metal, such as lead, inserted in the wire conveying the electricity to the light or lights.

Rule 6.—See that your wires—unless they have a waterproof covering—are kept free from wet.

Mr. Heaphy continues:—"This last rule is more important than it seems, for paradoxical as it may appear to those not versed in the subject, water can easily bring about a fire through its property of conducting electricity, several cases of wood being charred having already arisen, and a fire in America has occurred from this cause.

"The above rules apply to incandescent lighting only, as in every case of arc or semi-incandescent installations an inspection will probably be made by the Fire Office insuring the building.

"In order to prevent any unnecessary alarm in the mind of the public, I may state that all my experience so far has not caused me to alter in any way the opinion contained in my report, viz:—'That where systematic and proper precautions are taken there is less danger from electric lighting than from gas; but that if carelessly or ignorantly arranged or improperly worked then serious fires may be apprehended.' Unfortunately the demand for competent men to lay the wires is already exceeding the supply.

"It is only fair to state that the care taken to prevent fires by one or two of the electrical companies deserves much praise. I regret having to withhold their names, as I do not wish the accusation brought against me of giving undue prominence to any of them."

COMPLETION OF A NEW ATLANTIC CABLE.—We observe in the *Standard* of the 28th inst. a note with the above heading, which appears to us slightly confused. The *Times* has precisely the same note, but headed "Atlantic Telegraphy." "Among the passengers arriving at Plymouth yesterday by the Royal Mail steamer, *Nile*, were forty-two of the staff of the Silvertown Cable Company, from Panama. They comprised electricians, engineers, &c., and were returning to London upon the completion of the new cable which has been laid from England to Panama. The time occupied in the work has been remarkably brief; but a year elapsed from the commencement to the termination, as not a single serious hitch occurred during this period. The steamers engaged have been the *Dacca* (?), the *Silvertown*, and the *Retriever*. The remainder of the staff of 118 persons were at Panama, under the direction of the chief electrician, Mr. Thomas Grey. Mr. Matthew Grey, the second electrician, reached Plymouth yesterday, and proceeded with his coworkers in the *Nile* to Southampton."

THE PANAMA EARTHQUAKES.—A *New York Herald* telegram, dated Panama, September 8th, says:—"Mr. Robert Gray, F.R.G.S., the chief of the India-Rubber and Telegraph Works, of Silvertown, with Mr. Joseph Stearns, Central and South American Telegraph Company, report an earthquake in the Bay of Panama some six weeks ago. It was felt on the *Silvertown* cable ship. Mr. Gray also reports another up the coast, likewise felt on board, following it.

"The West India and Panama cable is reported broken."

TELEPHONE EXTENSION.—By an arrangement with the Post-office authorities, several subscribers to the National Telephone Company's Aberdeen Exchange will shortly enjoy the privilege of communicating direct with the Post-office in that city.

TELEPHONIC COMMUNICATION WITH DIVERS.—Mr. Wake, engineer of the River Wear Commissioners, and Mr. Irish, Manager of the Northern District Telephone Company, have recently been engaged in a series of experiments with a telephone arrangement specially devised by the latter for conversing with a diver in his dress when engaged in submarine work. On the 15th instant, Mr. Stone, a diver, descended in his dress to the bottom of the dock, where he successfully carried on an animated conversation with persons on *terra firma*, asking at various times for implements used in diving operations to be sent down to him, and putting questions to the persons on land. These experiments having proved so successful, it was thought advisable to exemplify the same at the North-East Coast Exhibition at Tynemouth, and on Thursday, the 21st, the telephone was severely tested by Mr. Lambert, of the firm of Siebe and Gorman, submarine engineers, who descended on three occasions during the afternoon into the diving tank, and placed himself in all the positions that a diver has to assume in order to carry out his work. The length of cable used in these experiments, through which the conversations were carried on, was 600 yards.

THE SCOTTISH TELEPHONE CASE.—We hear that Mr. Maclean, the defendant in the recent telephone trial in Edinburgh, has been declared a bankrupt at the instance of the United Telephone Company.

POST-OFFICE TELEGRAPHS.—The competition of young girls to obtain appointments in the Post-office telegraphs is rather increasing than abating. An examination was held on Wednesday last, at which there were no less than 800 candidates for 30 appointments. The salary is very small, commencing at 10s. per week only.

TELEGRAPHING WITHOUT WIRES.—A friend has brought before our notice a book entitled "Electricity and the Electric Telegraph," published in 1852, and written by George Wilson, F.R.S.E., who, in speaking of schemes for telegraphing across the Atlantic and the Pacific, says:—"One of these, whether hopeless or not for immense distances, is so very ingenious and so likely to succeed across limited spaces, that we cannot pass it unnoticed. It dispenses, except to a very trifling extent, with wires, and carries the current *both ways* through moist earth and water. It is desirable, for example, to telegraph from the right to the left bank of a broad river. From the copper end of a battery on the right bank a wire is carried to the shore (on the same side) and soldered to a plate buried in the river below water-mark. A wire is also led from the zinc end to a long coil of wire which ends in a metallic plate. This likewise is buried in the river below water-mark on the same right bank, but at a distance from the battery *considerably greater* than the breadth of the river across which signals are to be sent. On the left bank two plates are immersed opposite those on the right bank, and connected by a wire.

"The electricity on leaving the battery has, therefore, the choice of two paths. It may either keep entirely on the right bank, passing from the one buried plate on that side to the other, and so back to the battery by the long coiled wire; or it may cross to the left bank through the water, traverse the wire on that side, return across the water to the right bank, and regain the battery by the shorter wire. The Thames has been actually crossed by electric currents in this way; the resistance to their passage by the water between the banks being less than that between the ends of the wires on the right and left bank respectively."

LIGHTNING CONDUCTORS.—As an outcome of the recent instructions issued by the Home Office for the examination of lightning conductors, the city superintendent of Edinburgh has applied to this Town Council for authority to obtain apparatus and to employ professional assistance in inspecting lightning conductors.

TENDERS INVITED.—The Post-office authorities invite tenders for red fir telegraph poles, and for creosoting the same. The poles to be delivered in lots at the Northumberland Dock, Tyne or West Hartlepool, Perth, and Dublin. Forms of tender, containing all particulars, may be obtained on application to Mr. W. H. Winter, Controller of Stores, Telegraph Street, London.

IMPROVEMENTS IN ACCUMULATORS.—We have received another letter on the above subject from M. Blanchart, which however we cannot insert, as we closed our discussion with him last week. He charges us with employing derisive, instead of serious, arguments; and concludes by saying that the real cause of our exchange of correspondence was an erroneous interpretation of the figures which he gave. We thank M. Blanchart for the courteous manner in which he has met our remarks, and we cannot bring the matter to a close without expressing a wish that we may again be favoured with our correspondent's views on other things electrical.

HYDRO-DYNAMIC EXPERIMENTS; IMITATING BY LIQUID OR GASEOUS CURRENTS THE STRATIFICATIONS BY ELECTRIC LIGHT IN RAREFIED GASES AND THE VARIOUS FORMS OF THE ELECTRIC SPARK.—By M. C. Decharme. —To imitate by the hydrodynamic method the stratifications of the electric light in rarefied gases, I employ a procedure analogous to that which I made use of in imitating the magnetic shadow by an electric current in a plane parallel to its direction; that is, above the plate covered with a stratum of red lead there is transported horizontally and rapidly a tube of greater or less width, whilst water flows from it, or whilst air is blown through it. The current is thus projected and is spread out in a straight or curved line over the pulverulent deposit. The traces which it there produces are often preserved with their delicate forms. For certain effects a current of air may be advantageously substituted for one of water. By varying the experimental conditions we find among the designs obtained forms analogous to those of the stratifications of the electric light in gases rarefied to different degrees.

As for the numerous effects produced by the two methods of experimentation, I content myself with pointing out the principal results relative to hydrodynamic imitations; the corresponding phenomena among electric effects will be easily recognised.

The strata are the more apparent as the stratum of red lead is thinner, still beyond a certain limit the effects disappear. The strata are the more numerous and close together as the furrow produced is narrower, or, in other words, as the tube employed is narrower. They are generally in arcs of circles or in broad bands, sometimes in the form of a V, like those which Mr. Warren de la Rue has shown in his fine researches on the electric discharge.

It is frequently found in separate drops analogous to the globular strata given by the electric discharge through a tube containing carbonic acid at the pressure of 0·5 millimetres.

The multiple and relatively very large circles which surround the origin of projection of our figures are not without analogy with the aureolar or rather globular, forms which the electric light assumes at the positive pole, whilst at the negative pole there is a simple tuft. In like manner at the other end of the pulverulent furrow there appears a kind of tuft, like a flame.

Our hydrodynamic imitations of the stratifications of the electric light show all the degrees of the phenomenon, from the plain, unstratified current, to the current with drops visibly separate and passing through all the intermediate forms.

The author's memoir comprises further the hydrodynamic imitation of the different forms of the electric spark, of the figures of Lichtenberg, and of the projection effects of a metallic wire volatilised by the electric discharge.—*Comptes Rendus.*

ON THE FORMATION OF SECONDARY ELEMENTS OF LEAD PLATES.—By M. G. Planté.—The operation which I have designated under the term *formation* of secondary elements consists in a preliminary electro-chemical preparation of these elements with the object of deeply oxidising one of the electrodes and reducing the other to a state of metallic division, which enables the chemical actions to exert themselves more completely during the charge and the discharge, and to accumulate, in consequence, a greater quantity of the chemical work of a primary current. I have sought to perfect this operation. When studying the chemical actions produced in these couples, I have observed at first the transformation of one part of the peroxide of lead into a sulphate of the same metal under the action of the water, acidulated with sulphuric acid, in which the elements are plunged, a result which has been recently confirmed by Messrs. Gladstone and Tribe, in an interesting investigation on this subject. I have sought to increase the capacity of accumulators by producing a galvanic deposit of lead upon the electrodes, so as to make the oxidising action of the primary current penetrate more deeply by reason of the exceptional porosity of the electro-chemical deposits. To this end the most varied combinations were tried, and the majority of the compounds of lead, soluble and insoluble, without obtaining deposits sufficiently coherent and adhesive, and whose electric contact with the electrodes could remain indefinitely secure. I finally reached the conclusion that the best method was to endeavour to transform the metal itself of the electrodes almost in its whole thickness into galvanic peroxide of lead on the one hand, and of reduced lead on the other. I arrived at this result by a series of changes in the direction of the primary current with intervals of rest between.

To give an idea of the effects obtained by this method, I will add that with a secondary element already partially formed, the lead of which weighed 1½ kilo., the current of discharge which yielded at first a deposit of copper of 7 grms. in a voltameter gave, after a new change of direction, a deposit of 11 grms., then after an interval of rest and another change of direction a deposit of 18 grms., and 12 grms. per kilo. of the secondary element, which corresponds to more than 36,000 coulombs.

This is not, however, the limit which can be obtained, for a new change of direction determines a new increase in the quantity of chemical work accumulated, and so on. There is no other limit than the thickness of the lead plates. Admitting that we only seek to transform half the thickness of the metal, preserving the other half as the body of each electrode, and even that the peroxide is only reduced to protoxide at each discharge, we may hope to obtain by this method a discharge current sufficient to deposit about 74 grms. copper per kilo. of the lead of the secondary element, which represents a very considerable quantity of electricity.

This system of changes of alternate directions has not merely the effect of augmenting successively the layer of peroxide of lead formed at the expense of the metal of one of the electrodes, but also of transforming to a corresponding depth the other electrode into lead galvanically reduced, so that whilst the hydrogen derived from the decomposition of water in the interior of the element reduces the peroxide of lead formed by the primary current the oxygen may oxidise at the same time an equivalent quantity of metallic lead.

We may explain the efficacy of the intervals of rest between each change of direction by considering that after a certain time the plates of lead thus modified become less good conductors at their surface. Hence it results that on submitting them again to the action of the primary current it follows naturally in traversing the liquid the path of least resistance. It does not pass directly by the oxidised surface, but by the subjacent metallic surface to which the liquid penetrates. It thus oxidises by the mere fact of its passage a new layer of metal and it peroxidises also by degrees the exterior surface which has been already oxidised, or it effects the inverse work of reduction if the direction of the current has been changed.

Thus a kind of galvanic cementation is effected, in consequence of which the two plates of lead are profoundly modified in their structure; for the one is then found to be partially formed of crystalline and brilliant peroxide of lead, and the other of reduced lead, with an appearance equally crystalline. When a secondary element is in these conditions it preserves its charge well enough to give, after four months, luminous and thermic effects.

This method certainly requires a long time, especially at the commencement. To facilitate the attack of the lead by the electro-chemical action of the primary current, I have observed that the *formation* of the secondary elements is accelerated by raising the temperature of the liquid in which they are immersed either beforehand or during the action of the current. But as this use of heat presents som- -ffor- culties in practice I have had recourse to anot' - the work which gives very satisfactory results.

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This process consists in submitting the secondary elements to a sort of thorough cleansing with nitric acid mixed with half its volume of water, leaving them immersed in this liquid for twenty-four or forty-eight hours. The elements are then drained, washed very thoroughly, filled with water acidulated with 10 per cent. of sulphuric acid, and submitted to the action of the primary current. By this immersion in dilute nitric acid a portion of the lead is doubtless dissolved, but the thickness of the plates is not notably diminished, and in consequence of the metallic porosity the chemical action is not confined to the surface of the lead plates; it is also exerted in the interior, it creates fresh molecular intervals, and it consequently facilitates the ulterior penetration of the action of the primary current.

The secondary couples thus treated can yield in a week, after two or three changes of the direction of the primary current discharges of long duration, whilst without the previous action of nitric acid they would only give the same results after several months. This process will, therefore, notably abridge the *formation* of secondary elements, and will contribute to facilitate their application.—*Comptes Rendus.* (*See* ELECTRICAL REVIEW, September 9th.)

THEORETICAL AND PRACTICAL CONSIDERATIONS ON THE PHENOMENA OF ELECTRO-MAGNETIC INDUCTION. APPLICATION TO THE ORDINARY TYPES OF MACHINES.—By M. G. Le Goarant de Tromelin.—In the first part of my memoir I establish the formulæ of the intensity and the electromotive force of the machines. I find thus, for the Siemens type—

$$(1) \qquad e = \frac{2\text{HLK} \cos a\, v}{g^2}$$

and for the Gramme type,

$$(2) \qquad e = \frac{\text{LK} \cos a}{g^2} (\text{H}\, v - \text{H}'\, v')$$

In these formulæ e is the electromotive force, H the intensity of the magnetic field traversed by the wires in the Siemens machine, or of the outer wires in the Gramme system, and H′ the intensity of the field traversed by the interior wires of the ring in the Gramme; K the half section of the wires of a plane perpendicular to the axis of rotation; L the length of one of the parts of a spiral parallel to the generator of the cylinder or of the ring; v the linear speed of the outer wires, v' that of the interior wires; g^2 the section of the wires submitted to induction and $\cos a$ a mean co-efficient depending on the number of sections of the coating and their position with reference to the lines of force.

On refixing the keeper of soft iron in the coating, I find by a new method in Siemens—

$$(3) \qquad e'' = \frac{2\text{H}_1\text{LK} \cos a\, v,}{g^2}$$

and in Gramme—

$$(4) \qquad e'' = \frac{\text{LK} \cos a}{g^2} (\text{H}\, v + \text{H}_1\, v').$$

On adding (1) & (3) and (2) & (4), we obtain the total electromotive forces in Siemens.

$$(5) \qquad \text{E} = \frac{2\text{HLK} \cos a\, v}{g^2}\ \text{H} + \text{H}_1,$$

in Gramme—

$$(6) \qquad \text{E} = \frac{\text{LK} \cos a\, v}{g^2} (\text{H} + \text{H}_1) - \frac{\text{LK} \cos a\, v^1}{g^2} (\text{H} - \text{H}_1).$$

The formulæ (5) and (6) show that the iron keeper in the coating acts merely by reinforcing the magnetic field, so that the current produced would have the same intensity if the iron was fixed, as if the speed possessed of the total arrangement were given to the induced wires alone.

The formulæ show that in the Gramme machine the keeper does not act like a screen preventing the induction from being produced in the interior wires of the ring, but that of the electromotor force which its presence develops, it annihilates in part the inverse electromotive force which is produced in the interior wires.

The first term of the second portion of the formula (6), represents the electromotive force due to the outer wires; the second portion that which is due to the inner wires. The resulting current is the difference between the two currents, proportional to the field traversed and the linear velocity possessed by the induced wires.

The total magnetic field being influenced by the current which circulates in the coating, the reaction produced upon the field must be taken into account.

I then calculate the new values taken by the electromotive force and the intensity when, in a generator of electricity of which we suppose the inducing field as constant, we replace the existing induced coil by another, alike in form and size, but wrapped with wire of a different thickness or of different size but geometrically similar to the former.

I show, then, that with a generator moved by steam, E may be obtained constant, whilst I varies inversely as the total resistance if the machine is fitted with a speed regulator, or otherwise we may obtain I constant and independent of external resistance, but E varying proportionally to that resistance if the steam-engine works with its valve wide open, on condition that we suppose the mean power transmitted constant and the magnetic fields saturated or constant.

The general theory of these machines devolves naturally from these considerations.

I conclude by the study of the tangential efforts and of the work to be overcome resulting from the electro-dynamic reactions produced in the generators of electricity.

A part of these latter propositions has been already discovered by M. M. Deprez, who has taken another point of departure, considering thereby the action of currents upon currents.—*Comptes Rendus.* (Author's abstract.)

OFFICIAL RETURNS OF ELECTRIC LIGHT COMPANIES.

LAING ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to May 17th, was filed on May 23rd. The nominal capital is £1,000,000, in £10 shares, but the only shares recorded as taken up are the seven subscribed for by the signatories to the memorandum and articles of association.

DOMESTIC ELECTRIC LIGHTING COMPANY (LIMITED).—The return of this company, made up to May 18th, was filed on May 31st. The nominal capital is £50,000, divided in 49,000 A shares and 1,000 B shares of £1 each. At the time of making up 7 A and 100 B shares had been allotted, but no call had been made.

HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY (LIMITED).—The return of this company, made up to June 1st, was filed June 12th. The nominal capital is £250,000, in £5 shares. Upon 17,980 shares £2 10s. per share has been called, and the full amount upon 7,020 shares. The total amount of the calls paid is £80,050.

GULCHER ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to the 13th inst., was registered 20th inst. The nominal capital is £300,000 in £5 shares. 27,937 shares have been taken up, and 16,576 shares have been issued as fully paid. A call of £1 has been made and responded to to the amount of £17,743 5s., which together with £82,880 considered as paid makes the paid-up capital £100,623 5s. The total amount of the calls unpaid is £10,193 15s.

RIVER PLATE TELEPHONE AND ELECTRIC LIGHT COMPANY (LIMITED).—The return of this company, made up to May 31st, was filed July 27th. The nominal capital is £100,000, in £5 shares. 3,290 shares have been taken up and £3 per share called thereupon. The total amount of calls paid is £9,870.

ELECTRICAL TRADING COMPANY (LIMITED).—The return of this company, made up to June 14th, was filed on June 17th. The nominal capital is £10,000, divided into 500 ordinary and 500 deferred shares of £10 each. 170 ordinary and 500 deferred shares have been taken up, and upon the former £5 has been called and the full amount upon the latter. The calls paid upon the ordinary shares amount to £717 10s. and upon the deferred shares £5,000, leaving £132 10s. unpaid.

INSULITE COMPANY (LIMITED).—The return of this company, made up to June 23rd, was filed July 3rd. The nominal capital is £20,000 in £10 shares. 1,000 shares have been allotted, 500 of which were issued as fully paid. A call of £10 has been made and responded to, and, including amount considered as paid up, the total amount of calls paid is £10,000.

NEW PATENTS—1882.

4484. "Manufacture of resistances for electrical purposes." J. H. JOHNSON. (Communicated by P. Uzell.) Dated September 20.

4490. "Secondary or accumulator voltaic batteries." A. KHOTINSKY. Dated September 20.

4492. "Improvements in apparatus for producing and regulating electric currents, for the production of the electric light, and in the lamps, fittings, and apparatus employed therewith, part of such apparatus being applicable to other purposes." A. R. SENNETT. Dated September 20.

4503. "Apparatus for governing electric currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21.

4504. "New or improved apparatus for measuring electric force and currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21.

4511. "Apparatus for storing, measuring, and regulating electricity." J. D. F. ANDREWS. Dated September 21.

4512. "Portable voltaic batteries." J. MACKENZIE. Dated September 21.

4525. "Manufacture of secondary batteries or accumulators." J. MAXWELL LYTE. Dated September 22.

4527. "Electro-magnetic engraving machines." B. J. CARTER. (Communicated by G. McK. Guerrant.) Dated September 22.

4532. "Improvements in regulating currents from voltaic cells and to and from secondary batteries when being charged and discharged, and in apparatus connected therewith." W. E. AYRTON and J. PERRY. Dated September 23.

4535. "Dynamo-electric machines." F. C. GLASER. (Communicated by C. Zipernowsky and M. Deri.) Dated September 23.

4543. "Improved means of producing electric currents for lighting and general purposes." F. SWIFT and A. J. M. READE. Dated September 23.

4547. "Dynamo-electric machines." R. BARKER. Dated September 23.

4548. "Improvements relating to mechanism for transporting goods and passengers by the aid of electricity, and the regulation of the speed of machinery driven by electricity." F. JENKIN. Dated September 23.

4555. "Dynamo-electric engines." A. LALANX and M. BAUER. Dated September 25.

4561. "Secondary batteries or electric accumulators." F. C. HILLS. Dated September 25.

4567. "Means or apparatus for obtaining mechanical effect by electrical energy." E. L. VOICE. Dated September 26.

4573. "Portable electrical apparatus for lighting gas flames." J. IMRAY. (Communicated by E. Arnold.) Dated September 26.

4580. "Decomposing alloys by electrolysis and dialysis, which invention is also applicable for electrotyping and other purposes." W. R. LAKE. (Communicated by H. R. Cassel.) Dated September 26.

4596. "Measuring and regulating electric currents." S. Z. de FERRANTI and A. THOMPSON. Dated September 27.

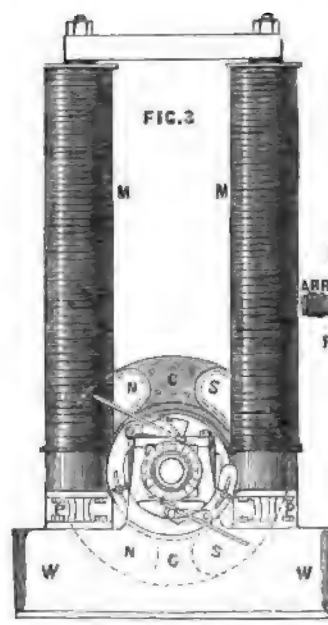
4599. "Construction of secondary or storage batteries, and preparation of the spongy lead to be used therein." W. CLARK. (Communicated by N. de Kabath.) Dated September 27.

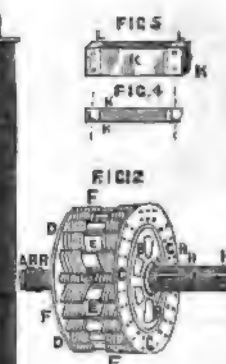
ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

329. "Telephone transmitters." SILVANUS PHILLIPS THOMPSON. Dated January 23. 2d. Relates to the employment of substances other than carbon in the instruments known as telephone transmitters, for which purpose it is proposed to employ the sulphide molybdenum or the sulphides of the following metals, viz.: lead, silver, antimony, bismuth, iron, nickel, cobalt, zinc, aluminium, manganese, mercury, thallium, or any other metallic sulphide or compound of the said sulphides, except only the sulphide of copper, and also the selenides, arsenides, phosphides, and antimonides of the said metals, or any of them, not excepting copper, also the oxides of iron, copper, and other metals, or the hydrates of the said oxides, except peroxide of lead. These substances, or any of them, it is proposed to apply, whether prepared artificially or existing as a native ore, either in masses, or in fragments, or in powder, to vary the resistance of a telephonic circuit, as carbon is applied in the carbon transmitters, by interposing them in the circuit of the current between appropriate conductors of platinum or other material. (*Provisional protection not allowed.*)

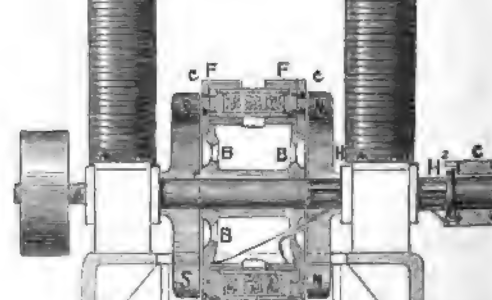
333. "Electric cables." T. J. HANDFORD. (A communication from abroad by P. B. Delaney, of America.) Dated January 23. 6d. Relates to that class of electric cables in which provision is made for obviating the effects of induction by the wires upon each other. The object of this invention is to interpose a continuous conductor into the meshes between the wires of a plaited or braided cable and thus eliminate from this class of cables the last vestige of induction.

756. "Machines for producing electric currents." J. BROCKIE. Dated February 16. 6d. Relates to the construction of the revolving armature. Fig. 1 shows in perspective the improved revolving armature, and consists of the main shaft, A, upon which the non-magnetic boss, B, is keyed—carrying the two iron rings, C and D. The cross-bars or magnets, E E E, are shown occupying the space between these iron rings, and to [illegible] are securely fastened. The coils, F F F, are wound on the extremities of the transverse bars, and the ends of the respective coils are led to the contact pieces, G G, forming the commutator. The shaft is preferably made hollow at the larger end, as shown, and the wires are led through the slots, H H H, into the interior of the shaft, whence they emerge by the other slots, H^2 H^2, and then to the contact pieces. The joining up of the several coils may be done in various ways. 1st, The free ends of each pair of coils may be led to contact segments on exactly opposite sides of the commutator; in this case twice as many contact pieces as there are cross-bars or magnets are required, and the currents in each coil are commutated separately, and they will be cut out of circuit during the revolution of the armature, except at those times when the rubbers or brushes make contact with the particular segments belonging to the coils. 2nd, Two or more cross-magnets could be joined up in series or in parallel circuit, and the two free ends of this system led





to contact pieces on opposite sides of the commutator. 3rd, The coils may be joined continuously, forming a complete circuit, and in this case any convenient number of wires may be arranged at equal distances making electrical contact with this circuit and led to each segment of the commutator in regular order. 4th, The coils may be joined up in pairs diametrically opposite each other. Figs. 2 and 3 show a complete machine constructed with the aforesaid armature. The pole-pieces, N N and S S, of the field or exciting magnets are bolted to brass or non-magnetic blocks, P P P P, which latter are in turn bolted to the foundation-plate, W. The faces of the pole-pieces are accurately planed or turned, and the revolving armature is also turned on the outside iron faces, so that a very small space intervenes



between the field-magnet, M, and the armature. Rings, R R R, are turned on the shaft, at the driving-end (fig. 1), and work in a thrust-block bearing to prevent end play. The inventor sometimes winds the middle part of the cross-bar magnets, E E E, and uses the current so produced to excite the field-magnets, in which case an additional commutator is required. The bar-magnets are constructed in layer of shown in plan at fig. 4 and in side view at fig. 5, where two diffi- plates, K K, are riveted to the end-blocks, L L, and a space formed which is filled up with several sheets of iron all.ocess, together, as shown, or filled with iron wire or iron filings, in fig. 2, in which latter case a covering will be required to

filings in position. The iron rings, C and D, are sometimes made with a deep groove cut in their peripheries, and these grooves are then filled up with soft iron wire or hoop iron for the purpose of reducing the tendency to heat and obtaining a better magnetic heat.

760. "Dynamo-electric and electro-dynamic machines." C. W. SIEMENS. Dated February 16. 6d. Relates to a construction and arrangement of a machine which can be used as a dynamo-electric machine for converting motive power into electricity, or as an electro-dynamic machine for converting electricity into motive power. A peculiar feature of the machine is that the same coils of insulated wire serve both for the induction of electrical currents and also for induction of magnetism. Fig 1 is an end view, and Fig 2 is

FIG 1

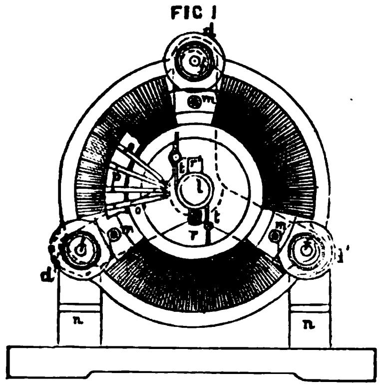
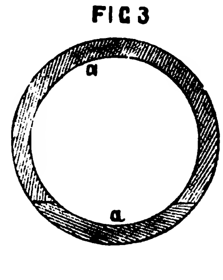
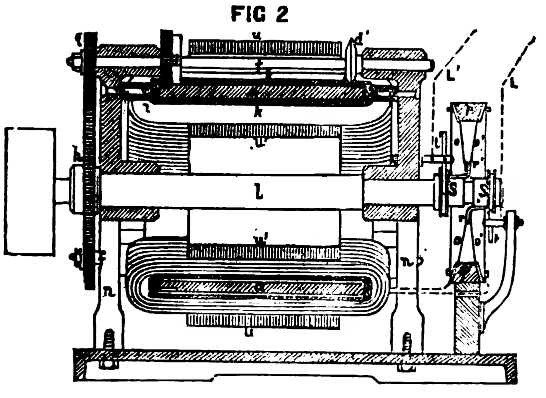


FIG 3



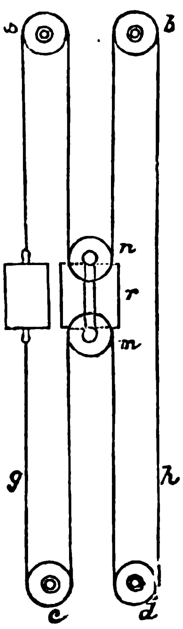
a longitudinal section of a machine according to this invention, fig. 3 is a transverse section of the iron cylinder which operates in the machine as a magnet. Two end frames, *n n*, fixed on a base, have bearings for a central shaft, *l*, and also for three shafts, *f*. Three bolts or screws, *m*, surrounded by short pieces of tubes secure to the frames, *n*, two rings, *i*, *i*, of non-conducting material, such as ebonite. To these rings are fixed an outer cylindrical shell, *k*, of sheet brass or other non-magnetic metal, and a similar inner shell, k^1, these two shells and the end rings to which they are fixed forming together a hollow annular casing, within which revolves the cylindrical magnet, *a*. This magnet, as shown in fig. 3, consists of a plate of iron bent round in cylindrical form, leaving about one-fourth of the circumference open, and this arc is filled in with a segment, a^1, of brass or other non-magnetic metal fixed to the iron and completing the hollow cylinder. Instead of bending the iron, *a*, in one piece, it

FIG 2



may consist of several thicknesses or of several lengths joined end to end. The hollow cylinder thus formed is of such size as nearly to fit, but to revolve freely within the casing enclosed by the shells, $k\ k^1$, and the end rings, *i*. It is maintained in position within the casing by three rollers, *d*, on the shafts, *f*, bearing against its periphery near one end, and other three rollers, d^1, on the same shafts, *f*, bearing against its periphery near its other end. To prevent end movement of the cylinder the rollers, d^1, are V-shaped and enter a V-groove in the cylinder. The cylinder is caused to revolve uniformly with the central shaft, *l*, in the following manner. On the shaft, *l*, is fixed a toothed wheel, *h*, which gears with pinions, *q*, on the shafts, *f*, and pinions, *e*, on these shafts gear with teeth formed at one end of the cylinder, *a*. The edges of the rollers, $d\ d^1$, and of the pinions, *e*, pass through slits in the outer shell, *k*. Around the shells, $k\ k^1$, are wound lengthwise a number of coils of insulated wire. A convenient number of such coils, as shown in fig 1, is 18, being 6 coils in each of the three divisions of the circumference, between the three blank spaces left for the rollers, $d\ d^1$, pinions, *e*, and screws, *m*, that fix the annular casing on which the coils are wound. The number of coils might be varied, but for the following explanation I will assume 18 to be the number as shown. The wire of each of the coils has two ends, consequently there are 36 wires connected in the following manner. A ring, *p*, of non-conducting material has fixed on each of sloping sides 18 springs, *o*, on the one side, and o^1, on the other. These springs may extend inwards radially, but it is preferred to incline them, as shown in fig. 1, forwards in the direction of rotation of the shaft, *l*. The springs, *o*, on the one side of the ring, *p*, and the springs, o^1, on the other side of *p*, incline towards each other, so that each spring, *o*, meets a spring, o^1, and the meetings of all the 18 pairs of springs is in a plane perpendicular to the axis of the machine. One end of the wire of each coil is connected to one of the springs, *o*, and the other end of the same wire is connected to one of the springs, o^1, not to that which meets the former, but to the spring next in order, so that the outgoing end of each coil becomes connected through the meeting of a pair of springs, *o* and o^1, with the ingoing end of the coil next in order, and if all the 18 springs, *o*, were simultaneously in contact with the 18 springs, o^1, there would be a closed circuit including all the 18 coils following in order. On the shaft, *l*, there are fixed two knives or separators, *r* and r^1, which as the shaft revolves pass between the pairs of springs, *o* and o^1, separating each pair successively. The knife, *r*, has on one side a metal face, and on the other side a face of non-conducting material such as ivory, and the spring, r^1, has a like facing on the side opposite to that of *r*, so that while the knife, *r*, is separating a pair of the springs, it makes electrical contact only with one of those marked *o*, and while the knife, r^1, separates a pair of springs it makes contact with one of those marked o^1. The knife, *r*, is connected to a ring, *s*, fixed insulated on the shaft, *l*, and the knife, r^1, is connected to a similar ring, s^1, and against these rings respectively rub brushes, *t* and t^1, which make connection to the wires, L L^1, of the external circuit. When the machine is employed dynamo-electrically by causing the shaft, *l*, to rotate, the action is as follows:—The iron cylinder, *a*, having certain residuary magnetism, in revolving through the coils induces in them electrical currents, and the currents so induced react on the cylinder increasing its magnetism until the machine reaches the limit of its power. The circuit of the coils being broken at successive points by the knives, *r*, r^1, separating the successive springs through the contact of which, if maintained, that circuit would be closed, the currents induced in the coils are directed by the knives, *r*, r^1, the rings, *s*, s^1, and the brushes, *t*, t^1, into the external circuit, L, L^1. Conversely when electricity is transmitted to the machine by the line-wires, L, L^1, currents are by the action of the knives, *r*, r^1, passed successively through the coils so as to cause the cylinder, *a*, to rotate and drive the shaft, *l*, the machine then operating as an electro-dynamic machine. The power of the machine for either use may be increased by an external shell, *u*, of iron encircling all the coils, and by an internal shell, u^1, of iron inside the coils. These shells, or either of them, may consist of convolutions of iron wire. It is sometimes desirable to make the machine reversible, so that the shaft may revolve in either direction. In that case each of the knives, *r*, r^1, instead of having one side of non-conducting material may have both sides metal separated by insulating material between them, and two additional rings, such as *s*, s^1, are provided with their brushes, one side of each knife being connected to a ring corresponding with *s* and the other side to a ring corresponding with s^1. By connecting one pair of the brushes, *t*, t^1, to the external circuit the machine is set to revolve in the one direction; but by disconnecting these brushes from the circuit and connecting the other pair to it, the machine is set for revolution in the opposite direction.

831. "Electric lamps, &c." J. RAPIEFF. Dated February 21. 6d. For the purpose of forming the arc for the production of light in an electric lamp between the points of carbon, and for feeding the carbons together as they burn away the inventor connects by any suitable means or appliances one or both carbon-holders to one movable axle, piston, or equivalent mechanism, in such a way that the movement of this mechanism in one direction shall bring the carbons together and the movement in the other direction shall separate them; this axle is operated by means of one or more weights or



springs or other source of power, in connection by suitable mechanical means with the above-named axle or its equivalent, in such a way that by acting through the medium of suitable electrical or electro-magnetic appliances there can be effected the rotation of this axle, or the movement of its equivalent, in either direction by opening or closing one of the two distinct parts of this mechanical connection. In the figure, *q* shows the weight and *r* another smaller weight—*a b c d* are pulleys on shafts fixed to a suitable frame—*n* and *m* are also pulleys attached to the weight, *r*, an endless cord or chain, *g h*, passes round these pulleys in such a way that it cannot ship round the pulleys, *a* or *b*, without revolving them, the weight, *q*, is attached to this cord by means of a clutch in such a way that it can be easily raised by hand during the time of charging the lamp. For the same purpose the pulleys, *a* and *b*, are provided with ratchet wheels

and pawls. The pulleys, *a* and *b*, are also provided either directly or by means of a train of wheels or other suitable means with a break or escapement actuated by an electro-magnetic appliance whereby the rotation is checked or impeded. So long as the pulleys, *a b*, are held stationary both weights remain suspended. By releasing the pulley, *b*, the weight, *r*, is allowed to descend. But so soon as the pulley, *b*, is checked and the pulley, *a*, released the weight, *q*, will descend, at the same time raising the weight, *r*. Now, if this weight, *r*, is connected directly or by suitable mechanical means with one or both of the carbons of the electric lamp it is easily understood that in the one case the carbons will be brought together and in the other case separated. To insure proper action of the mechanism the endless chain or cord should be tightened, and for this purpose the shafts of one or more pulleys, for instance, *c* or *d*, or both are fixed in the movable frame or fork which is tightened by means of a spring or springs, the tension of which is regulated by one or more set screws.

CITY NOTES, REPORTS, MEETINGS, &c.

THE AUSTRALASIAN ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).

On Thursday an extraordinary general meeting of the shareholders of this company was held at the offices of the company, 4, Copthall Buildings, Mr. R. Want, Chairman of the company, presiding, to consider, and if approved, to confirm the following resolutions, which were passed at an extraordinary general meeting, held on the 11th instant, that is to say:—"1. That the 69th of the articles of association of the company be amended by striking out the following words at the commencement thereof—namely, 'notwithstanding any rule of law or equity to the contrary.' 2. That the 71st of the articles of association of the company be amended by altering the figures '1885' occuring therein to '1884,' and altering the figures '1886' occuring therein to '1885.'"

The notice convening the meeting having been read by the secretary, Mr. J. H. Duncan,

The Chairman said: Gentlemen, you have heard the notice read for which this meeting is called. I need only repeat that the object of it is to consider, and if approved, to confirm the resolutions passed at a recent extraordinary general meeting on the 11th instant. These having been read, I do not think I need refer to them again, which were simply revisions made by the Stock Exchange Committee to meet their requirements.

Mr. Jackman remarked that he thought no reason was assigned by the secretary on the previous occasion for the alterations. He did not know it was so.

The Chairman said it was mentioned in the notice of the 11th August that they were in order to get a quotation and a settlement. The chairman then put the proposition, which was carried unanimously, and the business of the meeting ended.

Mr. Jackman inquired who Mr. "W. W. Duncan" was. That gentleman had taken upon himself to write upon the company.

The Chairman: I think he favours our company.

Mr. Jackman thought that gentleman should remember the terse proverb about proffered service. He need not say the rest. He was very sorry to receive it himself.

The Chairman remarked that the board had not the slightest knowledge of the writer.

Mr. Jackman asked if the board had received any satisfactory news from their agents.

The Chairman said the board had received nothing particularly new since the previous meeting. They had a number of letters, received last night, which they were about to examine that day.

THE ANGLO-AMERICAN TELEGRAPH COMPANY.—At a meeting of the Board of Directors it was resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending September 30th of 15s. per cent. on the ordinary stock and 30s. per cent. on the preferred stock, both free of income-tax, payable on November 1st to the stockholders registered on the books of the company on October 7th.

THE EASTERN TELEGRAPH COMPANY (LIMITED) announce the payment on the 13th of October next of a dividend of 3s. per share on the 6 per cent. preference shares of the company, less income-tax, for the quarter ended September 30th, 1882; and that an interim dividend of 2s. 6d. per share on the ordinary shares of the company, free of income-tax, will be paid on the same date.

TELEGRAMS FOR THE WEST INDIES.—The cable between St. Vincent and Grenada is interrupted; and as the cable between St. Thomas and St. Kitts is not yet repaired, there is at present no telegraphic communication with the islands of St. Kitts, Antigua, Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent, and Barbadoes. The Post-office gives notice that telegrams addressed to the above places will be subject to delay.

THE WESTERN UNION TELEGRAPH COMPANY.—The directors of the Western Union Telegraph Company have declared a quarterly dividend of 1½ per cent. The report submitted was favourable and showed a surplus, after allowing for the payment of the dividend declared, of 2,587,620 dols., against 1,666,240 dols. on July 1st.

THE CABLE-LAYING STEAMER *Scotia*.—After an absence of three weeks, the cable-laying steamer *Scotia*, Captain Cato, has returned to Plymouth, having successfully completed the repair of the cable of the Anglo-American Company from Brest to New York. It will be recollected that this vessel entered upon her task in May last. The break in the cable having been discovered, the position being 1,000 miles from the Channel, the cable was taken up and joined, and the *Scotia* left mid-ocean to make good the cable 400 miles from Brest, a "fault" having been ascertained to exist. While engaged in the second operation it was found that communication could not be had with America. Tests proved that the cable had parted where it had been joined. The *Scotia* came into Plymouth, replenished her bunkers, and again left. Having repaired the cable off Brest, the vessel proceeded to the position of the breakage, which was but twenty miles eastward of the spot where the cable had first given way. Great difficulties were encountered in taking up the wire and buoying it. It lay on a deep and uneven bottom, and time after time, after it had been buoyed, the buoys were carried away. When a little more than a month since the *Scotia* left the Atlantic for Plymouth the eastern end was buoyed. On her return, however, the buoy had disappeared. No further mishaps were encountered. The cable was completed, messages were passed through, and the *Scotia* was ordered to Plymouth.—*The Times*.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Sept. 27.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	12¼-12⅞	12½-⅛.13.12⅝
		Do. Do.	10	24 - 28	26½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	..	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	1⅛
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1 - 1½	
25,000	5	Great Western Electric Light & Power Co.	2½	⅞- 1⅛	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	8¼- 8⅝	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	[illegible]
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅛- ¼	
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1½- 2½	
..	..	South African Brush Electric Light & Power Co.	2½	½- 1	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2½	
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	50½- 51½	50*.1½
2,441,800*l*.	Stk.	Do. Preferred } Def'd. receiving no div. until	100	82½- 83½	83¼.¼.[illegible]
2,441,800*l*.	Stk.	Do. Deferred } 6 p. c has been paid to Pref.	100	19 - 20	20½
130,000	10	Brazilian Submarine, Limited	10	11⅞- 12⅛	
16,000	10	Cuba, Limited	10	9½- 10½	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6¼- 6⅞	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11[illegible]
100,000*l*.	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10¾- 11	10[illegible]
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l*.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -105	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	101 -105	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅛- 11⅜	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	105 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l*.	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	101 -104	
345,700*l*.	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6⅞	
163,209	10	Do. 6 per cent. Preference	10	12⅛- 12⅝	
125,000	10	Great Northern	10	12⅜- 12⅞	12⅞
100,000*l*.	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	27½
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	29½- 30½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	1½- 2½	
8,200	10	Do. 8 per cent. Preference	10	8 - 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	2[illegible] -2[illegible]	
58,225	1	Do. Scrip	1	[illegible]	
4,200	Cert.	Submarine Cables Trust	100	102 -107	
37,350	12	Telegraph Construction and Maintenance	12	30 - 31	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1[illegible]	
30,000	10	West Coast of America, Limited	10	4½- 5	
150,000	100	Do. 8 per cent. Debentures	..	[illegible]	
69,910	20	Western and Brazilian, Limited	20	6[illegible]- 7[illegible]	
200,000*l*.	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -125	
1,030,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1½- 1[illegible]	1⅞
34,563	10	Do. 6 per cent. 1st Preference	10	8[illegible]- 9	
4,669	10	Do. 6 do. 2nd do.	10	7[illegible]- 7[illegible]	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1⅝	1.0[illegible]
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	¾- 1	
100,000	5	United Telephone Co.	5	10½- 10⅞	

* Exceptional amount at special price.

TRAFFIC RECEIPTS.

The West Coast of America Telegraph Company (Limited). Gross earnings, Traffics and Steamer, month ending July 31st, 1882, £3,475, against £3,120 in the corresponding period of last year. Month ending August 31st, 1882, £3,400, against £3,185 in the corresponding period of last year.

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 15th September are £1,647, as compared with £1,692 in the corresponding period of 1881. The June receipts, [illegible] at £5,089, realised £5,131.

The Western and Brazilian Telegraph Company (Limited). The [illegible] receipts for the week ending 8th September, 1882, were £2,175; and f[illegible] the week ending September 15th, 1882, were £2,161; and for the week endin[illegible] September, 1882, were £2,309, after deducting the "fifth" of the gr[illegible] receipts payable to the London Platino-Brazilian Telegraph Company (Limit[illegible]

iron filings required

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 254.

ELECTRICAL NAVIGATION.

We have recently had sent to us a small illustrated pamphlet of an interesting character, written by M. Georges Dary, who is evidently a great admirer of the eminent French electrician, M. Trouvé. The little work has its pages devoted to the electrical inventions and ideas of Trouvé, but it deals more particularly with the matter of electric navigation, for which purpose the well-known Trouvé electro-motor was more especially designed. The idea of propelling vessels by means of electricity has been a subject to which many electricians of the past and present have turned their serious attention, and it has just received an addition to its history which will probably form a starting point for an immediate development of this method of propulsion. In the *Times* of the 29th ult., there appeared a letter bearing the signature of Professor Silvanus Thompson, describing the trial trip of an electric launch very appropriately named *Electricity*, and which he states to be the first ever propelled upon the waters of the Thames by the motive-power of electricity. The little craft, on board of which Prof. Thompson formed one of a party of four, is 25 ft. in length, about five ft. in the beam, draws about two ft. of water, and is fitted with a 22-in. propelling screw.

Two dynamo-electric machines, known as the Dr Siemens', were furnished with proper reversing gear and regulators to serve as engines to drive the screw propeller, and either or both of these could be switched into circuit at will. The current for actuating these machines was supplied by 45 secondary cells of the Sellon-Volckmar type, and when fully charged they were calculated to supply force for six hours at the rate of four horse-power. The little vessel started from the wharf of the Electrical Power Storage Company at Millwall, and was propelled citywards at the rate of about eight knots an hour against tide.

She reached London Bridge at 4 h. 37 m., and was then put about, returning on the ebb to Millwall at 5 h. 1 m., the return journey, therefore, occupying just 24 minutes. The distance between these two points is, roughly speaking, about 3¼ to 3½ miles. Professor Thompson adds for the benefit of electricians that the total electromotive force of the 45 accumulators was 96 volts, and that during the whole run the current through each machine was steadily maintained at 24 ampères. He calculates that this corresponds to an expenditure of electrical energy at the rate of 3 1-11ths horse-power.

M. Georges Dary, in his pamphlet, states that on the 26th May, 1881, the passers-by stopped in crowds upon the bridges to look with astonishment at a light craft, in the midst of the numerous river steamers which plough the Seine in Paris, which went up the stream without any visible motor. It was stopped, resumed its progress, or slackened, without any observable movement of its steersman, who appeared motionless at the stern. It was not long before it was learnt that this was a new application of electricity, coupled with the name of M. Trouvé and his electro-motor. This apparatus is well known to all those who visited the Paris Electrical Exhibition of 1881.

To the Russian Professor Jacobi belongs the honour of attempting to propel a boat by means of electricity for the first time. M. Jacobi compiled in 1834 a report, which he presented to the Academy of Sciences of St. Petersburg, on electro-magnetism applied to machinery.

In 1839 the Czar Nicholas allowed 60,000 francs to M. Jacobi, and ordered him to construct a primary electric motor, and to adapt it to a boat. The machine, composed of electro-magnets which communicated motion to two wheels with armatures, was actuated by a Grove battery of 128 couples.

The invention was apparently successful, and the boat traversed the River Neva to the great admiration of the spectators. The experiment, however, eventually turned out to be a failure, and Jacobi himself looked upon the question as insoluble. Twenty years later another attempt at electrical navigation took place on the lake in the Bois de Boulogne, which however turned out as unfortunate as its predecessor. The failure in both cases may be attributed to two causes: the use of ordinary galvanic batteries, and the want of such dynamo-electric machines as we now possess. Probably, had it been in the power of Jacobi or his successor to have had at command Planté's, Faure's, or the Sellon-Volckmar secondary cells, the crude motors of those days might have been made to give better results; and on the other hand, had our present dynamo-electric machines been in existence, then ordinary galvanic batteries could have been employed to more advantage. In neither case, however, could commercial success have been attained, for the dynamo is as necessary to charge the accumulators cheaply as it is to act as a motor.

We may therefore agree with M. Dary that true electrical navigation dates from the first experiment with the Trouvé boat. Experience has always shown that discoveries of such a nature as that we are now dealing with require years of labour before the highest degree of perfection of which they are susceptible is attained. We look with satisfaction on what has been already accomplished during the last year or two in electrical navigation, and if the hope existed in years gone by that the application of electricity to this purpose might be extensively employed, how much more may we now cherish the belief in the face of the present investigations that the future belongs to electricity; or, quoting the words of Prof. Thompson, "who shall say to what proportions this latest application may not attain in the next decade."

Since penning the above lines we have been favoured by Prof. Thompson with further details concerning the *Electricity*, which will be found in our "Notes" columns; and on Thursday morning, through the courtesy of the Electrical Power Storage Company, we had the pleasure of a trip from Millwall to London Bridge, the little vessel being in charge of Mr. Philippart, jun., to whom we desire to return our best thanks for the attention we received at his hands, and also for information imparted to us respecting the various points of interest connected with the working of the launch.

ATTRACTION AND REPULSION DUE TO SONOROUS VIBRATIONS, AND A COMPARISON OF THE PHENOMENA WITH THOSE OF MAGNETISM.*

PROF. GUTHRIE'S question as to whether *attraction* were changed into *repulsion* by the removal of one of the vibrating membranes to the extent of half a wave length, is one to which I gave some attention at the commencement of my research. It is perfectly reasonable to expect such an effect, and I have alluded to it in my paper, but being at the time in search of other effects, I did not further pursue my investigation in that direction.

Mr. Preece was quite right in suggesting that two membranes standing opposite each other and vibrating in opposition to one another, as shown in fig. 8 of my paper, might be said to be in *opposite* phase, instead of being in the *same* phase, as I have described; but I think we must in these experiments look upon the *effect* more than the *cause*, and when both membranes produce simultaneously alternate compression and rarefaction of the air near them, whatever be their position towards each other, we must look upon the vibrations as being in the *same* or *like* phase, with regard to the medium between them.

I understand that Mr. Preece's suggestion arose from the desire to make the analogy between the two sets of experiments *perfect*, but the last experiment described in my paper (see figs. 36, 37, and 38) shows that this cannot be done.

In this experiment, which I consider an important one, for in it two effects are combined, a little disc (fig. 36) places itself *parallel* with the axes of the drums, whose membranes are vibrating in like phase (fig. 37*a*), while it turns at *right angles* to the axes between two similar poles of magnets. In both cases it is *repelled* from the central or axial position.

Were we now to reverse the order of things and call the phase of vibration of two membranes, as represented in fig. 37*b*, the *same* or *like* phase, and compare it with two similar poles of magnets, then we should obtain certainly a position of the disc at right angles to the axes of drums or poles in *both* cases; but, between the vibrating membranes, it would be *attracted* towards the axial position, while, between magnetic poles, it would be *repelled* from the axes of the poles towards the position XX., fig. 38*a*. Therefore, by setting one difference right, another would appear, and the change of terms would not help us in any way.

Prof. Foster asked, very pertinently, what would take place when the phase of vibration of the two membranes was neither the *same* nor *opposite*, but *quarter* phase. My apparatus, as at present constructed, does not admit of the production of this effect, but I have not the slightest doubt that, in the case mentioned by Prof. Foster, there would be neither *attraction* nor *repulsion*.

All the experiments described in my paper, and which I have shown this evening, are such as can be compared with corresponding magnetic experiments; but there are others which will not compare with magnetism, and which are nevertheless interesting in connection with the investigation.

For instance, I have shown by the two cardboard discs, represented in fig. 25 of my paper that we obtain apparent *attraction*, caused probably by the momentum of the expelled air creating a partial vacuum as described; but, if by some means or other I prevent this momentum taking place, say, by placing a flange or rim round the disc (shown in fig. 39), the conditions are entirely altered. If I move such a disc with a flange to and fro in front of a suspended disc, in the manner described in the experiment (fig. 25), we obtain *repulsion*, while as soon as I remove the flange from the disc we have *attraction* again, as before.

This experiment may be varied by taking a piece of brass tubing of about 9 centimètres in diameter, and about 7 or 8 in length, into which fits loosely a wooden piston with a rod, as shown in fig. 40, and presenting one end of the tube to the suspended disc (fig. 25) while moving the piston within the tube to and fro, then the tube acts in a similar manner as the rim or flange in the previous experiment, and *repulsion* is the result; but by placing a flange or disc of about 14 centimètres in diameter, as shown in fig. 41, on the end of the tube which is presented to the suspended disc, *attraction* is again obtained. It is worth noticing that the flange in this experiment forms a flat surface at *right angles* to the axis of the tube or the piston rod, while in fig. 39, where the *opposite* effect is obtained, the surface of the flange is *parallel* with axis or rod.

A similar experiment may be made with the drum and vibrating membrane. We have seen that a single vibrating membrane will attract a disc, D, fig. 12, but when a short piece of tube is placed over the drum, so that the end of the tube projects beyond the drum and membrane to the extent of a few millimètres, as shown in fig. 42, *repulsion* of the disc, D, is the result, while a little flange of three millimètres in depth (shown in fig. 43), when placed on the end of the tube, will have the effect of converting the repulsion into *attraction* again, as before.

I may be excused here for indulging in a little speculation, viz.: We are all aware that there is no substance known at present which will insulate magnetism, or, in other words, which the magnetic lines of force will not completely penetrate. If we had, however, such a substance, and were able to make a tube of it, and place it over the pole of a magnet, in the manner shown with the drum, and thereby cause the lines of magnetic force to be altered or diverted into a different direction, *perhaps* (and I only venture to go so far as to say *perhaps*) we should obtain similar results with a magnet as those I have just shown with the disc and the vibrating membrane.

Prof. W. G. Adams, F.R.S.: Mr. Stroh has given beautiful illustrations or vortex motion in liquids and in gases. He has shown us the complete analogy between the motions of gases and the motions of liquids, as shown by the experiments of Prof. Bjerknes (which many of us had the pleasure of seeing last year in Paris), when they are set in motion by vibrating discs. He has shown us also the close analogy between the motion of such vibrating discs in the presence of liquids or gases, and the motion of a magnetic needle in a magnetic field. I would like to make a few remarks with reference to the cause of these apparent attractions and repulsions of the vibrating discs in Mr. Stroh's and Prof. Bjerknes' experiments, and to draw attention to the relation which these experiments have to the beautiful experiments of Mr. Froude, whereby he proved some years ago that when a fluid is in motion, but with different velocities in different parts, the whole amount of energy of motion of the fluid being a constant quantity, where the velocity is greatest the pressure of the fluid is least.

From the principles of conservation of energy, we should expect that, in a fluid in motion, if part of the energy is spent in increasing the velocity of the moving particles, there must be less potential energy or diminished pressure.

Mr. Froude showed this experimentally, by allowing a stream of water to flow through a pipe of varying diameter in different parts. Where the pipe was contracted, and therefore the velocity of flow increased, the pressure was diminished, and, where the pipe was largest, there the velocity of flow was least and the pressure was greatest.

Thus, if E F (fig. A) be a pipe through which a liquid is kept continually flowing, and if tubes, A, B, C, D, be inserted at various points, the height of the liquid in these tubes will indicate the pressures at the several points, and these heights will be found to be least where the pipe is smallest—*i.e.*, where the velocity is greatest.

Now let us see what bearing this principle has on Mr. Stroh's experiments. If we take the case of the vibrating disc, which is attracted when the back of the hand or a disc not in vibration is presented to it, immediately in front of the centre of the disc, the changes of velocity of motion of the fluid are the greatest, and the mean square of the velocities has its greatest value, and hence the average pressure in this position is less than in other parts of the fluid.

In going out from the centre of the disc in any direction, the average velocity diminishes, and, as the energy of motion depends upon the square of the velocity, and will therefore be the same whether the motion be backwards or forwards, the average pressure will gradually increase until we reach that portion of the fluid which is not in vibration. The external pressure on the tube and support of the disc being

* Supplement to Paper read by A. Stroh before the Society of Telegraph Engineers and of Electricians, April 27th, 1882.

THE TELEGRAPHIC JOURNAL AND
ELECTRICAL REVIEW.

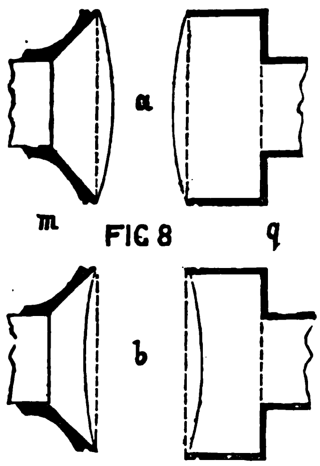


FIG 8

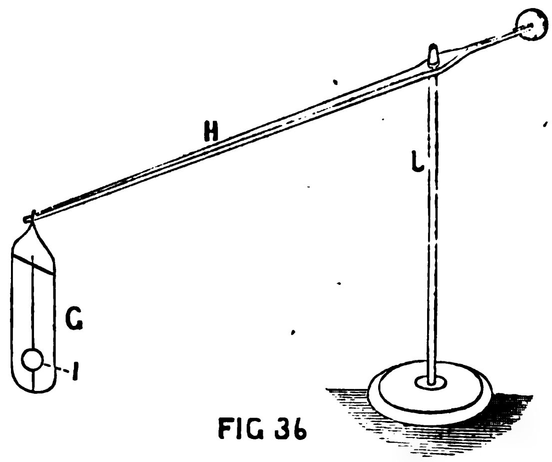


FIG 36

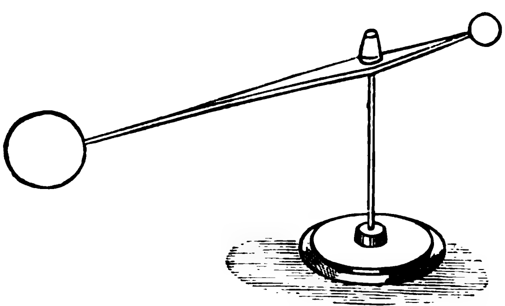


Fig. 12.

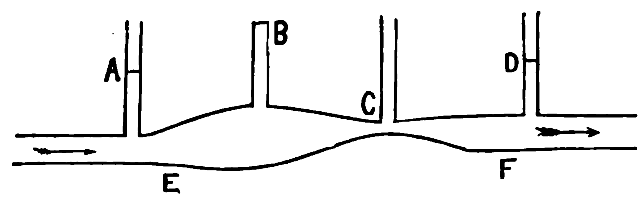


Fig. A.

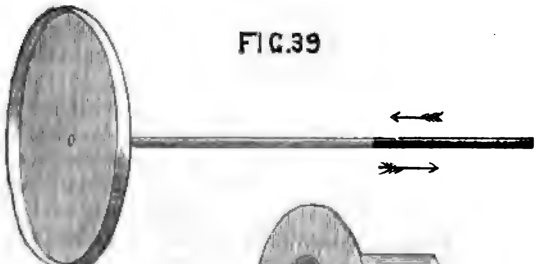


FIG.39

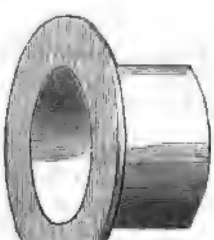


FIG.41.

FIG.40

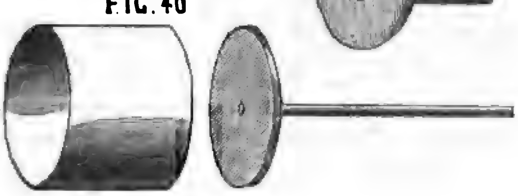


Fig. 43.

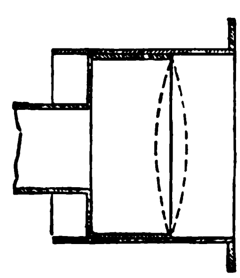
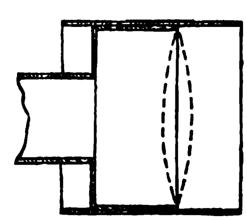


Fig. 42.



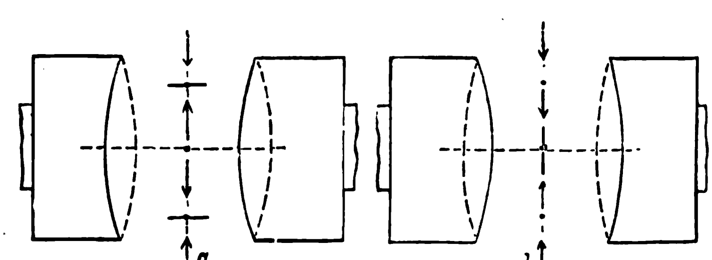


FIG.37.

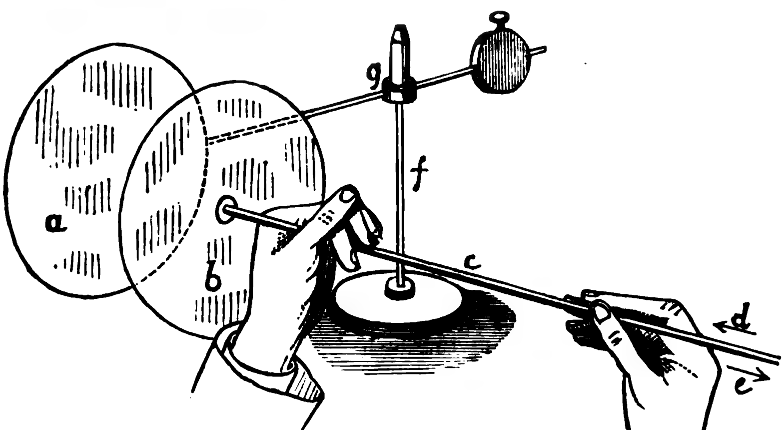


FIG.25

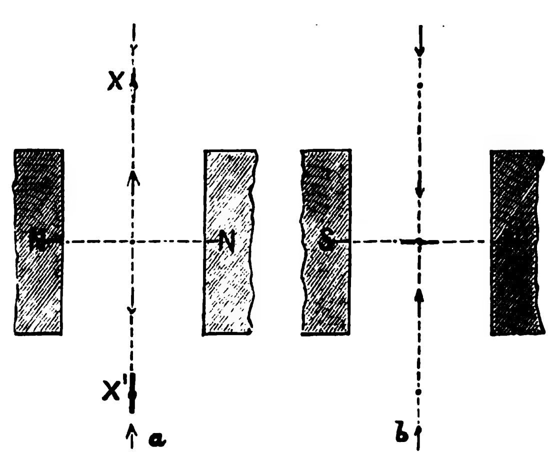


FIG.38

greater than the pressure immediately in front of the disc, the disc will move forward.

Take, again, the case of attraction of discs at the ends of two tubes placed opposite to one another, and both vibrating inwards or both outwards at the same instant (discs which Mr. Stroh describes as being in the same phase). In this case, in the experiment with glycerine and a coloured liquid, we saw (and I hope members noticed this point in the experiment) that the vortices were moving with different velocities in different parts of the four quadrants in which the symmetrical states of motion were set up. The velocities were greatest immediately in front of the discs where the threads of coloured liquid became suddenly drawn out, and hence we should expect that these were positions of least pressure, and that the resultant pressure in front of the discs is less than behind them, and consequently the discs will move towards one another. The thread of coloured liquid came slowly up along the face of the disc towards the centre, and the velocity gradually increased to its greatest value as the thread bent round to move in a direction perpendicular to the faces of the discs—outwards. In this central position, then, the pressure reached its least value, and the resultant pressure of the surrounding liquid caused the discs to move towards one another.

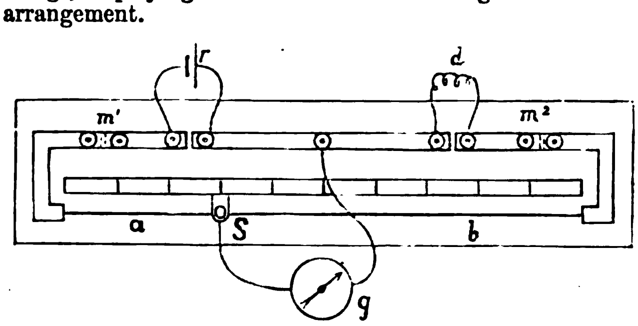
If there were any liquid or any substance by the vortex motions in which we could suppose magnetic effects to take place, then we should have a most complete analogy between these motions and the action of magnetic poles on one another.

In the case of gases, I apprehend that the cause is the same as in the case of liquids, that in fact the result has more to do with the actual motion of the gas than the change of density taking place in the gas itself, although both conditions of course are present.

MEASUREMENT OF BATTERY RESISTANCE BY MANCE'S METHOD.*

By H. R. KEMPE.

The resistance of a battery cell can be measured with a considerable degree of accuracy by means of the slide wire bridge, employing Mance's method. The figure shows the arrangement.



The general method of procedure is as follows: Having made the connections as shown (the gaps, m_1, m_2, being closed with the thick copper latches), the slide, s, is moved along the scale, the key being depressed at intervals, until the point is reached at which the depression of the key makes no change in the permanent deflection of the needle. When this is the case then

$$r = d\left(\frac{a}{1{,}000 - a}\right)$$

Thus, for example, suppose $d = 1$ ohm and $a = 450$ divisions, then

$$r = 1\left(\frac{450}{1{,}000 - 450}\right) = \frac{450}{550} = {\cdot}82 \text{ ohms.}$$

Generally speaking the test is simple enough, but there are several points which must be attended to in order that a [illegible]ct result may be obtained. In the first place it is [illegible]ary that the resistance, d, be greater than the resistance of the battery, though it should not be greater than about ten times the value of the latter. As a rule the complete slide wire bridge is furnished with four resistance coils of one ohm each, so that the choice of a resistance to insert in d is limited, and it may not be possible to follow out the rule of "making d larger than r, but not greater than about 10 times r." In this case the possibility of an accurate measurement becomes proportionally reduced below the highest possible standard, so that on the one hand a cell whose resistance is much less than one-tenth of an ohm or, on the other hand, a cell whose resistance exceeds four ohms, cannot be measured with the highest possible accuracy.

Strictly speaking, in order to insure accuracy it is necessary that the resistance of the portion of the slide wire, a, be less than the resistance of the battery to be measured; but as the resistance of the whole length of the wire will not exceed one-tenth of an ohm, the resistance of the length, a, will practically be less than the resistance of the battery, unless, of course, this resistance is extremely low. Assuming, however, that it is, say, five or six times greater than the resistance of the battery; then the next point to be seen to is that the deflection of the galvanometer needle does not exceed about 60°, nor is less than about 40°, for the success of the test depends upon a change in the current through the galvanometer being as perceptible as possible, and this would not be the case if the deflection was outside the limits laid down. If the deflection is too low then the only thing to be done is to employ a more sensitive galvanometer; but if the deflection is too high the galvanometer may be shunted until the deviation is brought within the limits mentioned. *In any case it is very necessary to employ a galvanometer whose needle is very freely suspended*, that is to say, *a galvanometer whose needle when deflected will change with a very slight change in the current strength.* It must not be supposed that by this we mean a very *sensitive* galvanometer in the ordinary understood sense of the term, that is to say, a galvanometer whose needle will deflect several degrees from zero with a very weak current; such a galvanometer may be perfectly useless for a test like Mance's. Practically, it may be taken that the only galvanometer of use for such a test is one with a needle suspended from a fibre; but there is not the slightest necessity for the instrument being a *sensitive* one as long as we can get a deflection of between 40° and 60°, when the apparatus is joined up to the bridge. A *compass* suspended needle, unless the pivoting is extremely good, is almost useless, no matter how *sensitive* it is to a weak current.

Provided the conditions laid down be perfectly followed out, and provided the slider is set so that on its depression the galvanometer needle does not change its deflection more than one quarter of a degree, then we can practically be certain of the accuracy of the result within one per cent.; that is to say, if the slider ought to theoretically stand at 100 on the scale when the required balance is obtained, then if it were one division out, the depression of the key should produce a slight but perceptible movement of the galvanometer needle.

The facility of making the test may be considerably increased by the following arrangement: Use a *sensitive* galvanometer of a resistance not exceeding about 10 ohms; then when all the connections are made, and the battery joined on, a strong deflection will be obtained. Now bring the needle as near back to zero as possible by bringing in its proximity a strong permanent magnet; this done, adjust the slider, s, till on depressing it no movement in the needle is observed. It will be found that with this arrangement a considerable movement of the needle will be produced on depressing the slider, s, when the exact adjustment of the latter is but very little out.

Another arrangement which may be very conveniently adopted is to employ a *sensitive* galvanometer of low resistance, wound with two wires. One of these wires would be joined in circuit with the bridge, the other would be connected in circuit with a small battery and a set of resistance coils, the connections being so made that the curre[illegible] through the two coils oppose one another. W[illegible] deflection due to the battery under test is ob[illegible] second battery and resistance coils are conn[illegible] then this battery is adjusted until the need[illegible] to zero as nearly as possible. The test is t[illegible] the case where a permanent magnet is used.

If the test is made with a very sensitive of low resistance, either with a permanent [illegible]

* We give this article in reply to one of our correspondents (see

a double wire and an extra battery, it is best to make *d* as nearly equal to the resistance of the battery as possible (it should not be made less), as in this case, since the slider, s, will have to be set near the centre of the scale, a greater range of adjustment is given to it, for five divisions near the centre portion of the scale (500 division mark) is equivalent to only one division near the 100 division mark. It is true the arrangement is not quite so sensitive as when the slider has to be set towards the end of the scale; but still, if we can employ a very sensitive galvanometer, this small loss of sensitiveness is more than compensated for by the increased range which can be obtained on the scale.

C. VERNON BOYS' METERS.

At the meeting of the British Association at Southampton, Mr. Boys showed and described a series of models and instruments of his invention for the integration of curves and electrical and mechanical forces. The first instrument described was a curve integrator, which is an exact mechanical equivalent of the formula of integration. It is chiefly of theoretical interest, since it clearly illustrates several of the well-known mathematical rules, and since it originates the logarithmic curve. The development of this instrument gives the disc cylinder integrator (fig. 1). A disc, mounted in a swivel frame, rests against a cylinder.

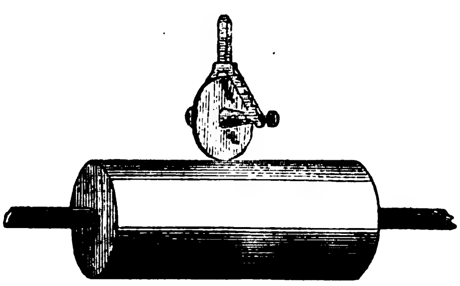


Fig. 1.

If the plane of the disc is parallel to the axis of the cylinder, longitudinal motion of the latter is unaccompanied by rotation, but if the swivel frame is turned, the disc will describe a screw line on the cylinder, which therefore must turn. The rate of turning is equal to the rate of longitudinal motion multiplied by the tangent of the inclination of the disc. This process of mechanical integration is the most perfect in existence, for it depends upon pure

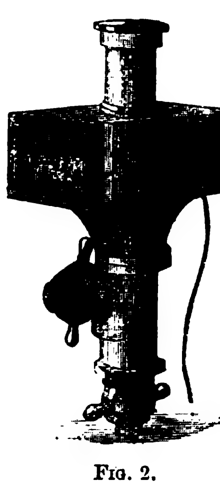


Fig. 2.

'ling only, and the force necessary to incline the disc, and moment of inertia of the disc and swivel frame, are infinitesimal; thus it is specially and indeed the only plicable to the case of delicate or rapidly varying

most important application of this integrator is the -power meter, an instrument which will find and record on a dial the amount of work done by steam or other fluid under pressure at either or both ends of the cylinder of an engine (fig. 2). The pressure or the difference of pressure determines the displacement of a piston-rod controlled by a spring, as in a Richard's indicator. A pin on the piston-rod entering a radial slot on a swivel frame inclines the latter, so that the tangent of the inclination is proportional to the steam-pressure or difference of pressure. A disc carried by the swivel frame rests against a cylinder which is moved longitudinally by a reducing lever or by pinion gearing connected with the piston-rod of the engine. The pressure multiplied by the rate of motion is the rate of doing work. These are represented by the inclination of the disc and the longitudinal movement of the integrating cylinder. The rate of rotation of the cylinder is, therefore, proportional to the rate of doing work, and the number of revolutions in any time gives the work done in that time.

The electric-energy meter is another application of the disc cylinder integrator. A cylinder is caused to reciprocate longitudinally by a mangle motion, driven by clockwork. Mounted in a common swivel frame on either side of it is a disc, against each of which the cylinder bears alternately. So long as the discs are horizontal the cylinder does not rotate, but if they are inclined it rotates always in one direction, for the cylinder bears against one in its forward and against the other in its return journey. The rate of revolution is proportional to the tangent of the inclination. The swivel axis carries a transverse beam, from one end of which hangs a weight, and from the other a solenoid made of a great length of fine wire, which is wound in opposite directions at the two ends. This solenoid hangs in the annular space between two solenoids of thick wire. The swivel axis also carries a pendulum weight to resist deflecting forces. The main current is made to pass in the same direction through the fixed solenoids, and a shunt current through the moveable solenoid which then is dragged down with a force proportional to the product of the currents, and therefore to the energy of the current. This causes the beam to be inclined, so that the tangent of the inclination, and therefore the rate at which the cylinder turns, is proportional to the energy of the current; the number of turns therefore is a measure of the total work done.

At one time Mr. Boys thought of applying the disc cylinder integrator to find the total quantity of electricity that has passed in a conductor; but various difficulties and the expense of such an instrument made it unsuitable for an electric meter such as would be fit to take the place of the gas meter. He therefore invented what he has called the "vibrating electric meter," which depends on a totally distinct but valuable principle. The rate of a clock or a watch is proportional to the square root of the strength of gravity or of the hair spring; the force of an electro-magnet on an armature is proportional to the square of the circulating current; if, therefore, gravity or the hair spring is replaced by electromagnetic force, the clock or watch will cease to measure time, but will go with a *rate* directly proportional to the current strength, the "time" measured is, therefore, the integral of the current or the quantity of electricity passed.

This principle has been applied in a great variety of ways, a description of which would occupy too much space; suffice it to say that the instrument has become more simple as it has become more perfect, so that at the present time the inventor thinks he cannot be far from the ultimate form. In one of the late instruments, there is a vertical vibrating axis, carrying an armature which oscillates between the poles of a horizontal electro-magnet excited by the current. The moment of inertia is increased by weights. As in a clock, an escapement of some kind is necessary to maintain the oscillations, so here, either a mechanical or electrical impulse must be given to the balance when necessary. With this object, a second electro-magnet is fixed and connected, so that when the amplitude has died down to a particular limit, a portion of the current in the first is for a moment shunted through it, and so gives an impulse which restores the amplitude to its former amount. There is an arrangement which, as soon as the current ceases, causes the vibrating axis to turn to one side, so as to be ready to start again. The meter may be used either to take the whole current or as a shunt. The main current that passes through it is never broken, so that the meter itself can in no way be a source of danger. The contact on which the meter depends is only occasionally made, and then in a decided manner and

with force, so that it is less likely to give trouble than one which is continuously on the point of being made. The quantity of electricity can be read from a dial without trouble.

All the instruments described so far have been integrators, that is, instruments to determine an amount *during* a time. There is another class of instruments devised by Mr. Boys, of which he showed one only. Its object is to divide the speed of one motion by the speed of another, and continuously record the quotient. If these speeds are the speeds of record of two integrators which are finding the

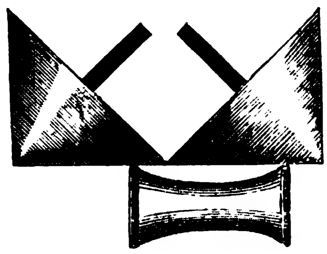


FIG. 3.

work put in and the work sent out of any combination of mechanism, such quotient measures continuously the efficiency of the combination, or generally, if the speeds represent any two things the divider will show continuously the value of one in terms of the other. Two soft iron cones are mounted base to base, so that the lowest line in each is horizontal and continuous (fig. 3). These are made to revolve, and a magnetised steel reel hangs on below and travels about, always showing by its position the ratio of the speeds of the cones. It may carry a recording pencil, if desired.

ELECTRIC LIGHTING AT HULL.

ON Thursday, September 28th, the electric lighting of some of the streets of the old town of Hull was officially inspected by the Mayor of Hull and the Lighting Committee.

The party assembled in the Town Hall at 7 p.m., and witnessed the starting of the lights in the various rooms and passages. Six arc lights of about 1,000 candle-power each, supplied from an S D_8 machine, and about a hundred Swan incandescence lights of 16 candle-power each, worked by two S D_2 machines, are employed for lighting up the building.

Later on the lights in the streets were started, comprising four 3,000-candle-power lights, each worked by a D_7 machine, and twenty-two 300-candle-power lights, worked by a W_1 D_7 machine in two circuits. The four strong lights are suspended from Williams' tubular poles, about 50 ft. above the roadway, and are enclosed in lanterns similar to those in use at the Royal Albert Dock. They are placed one on the pier, the second on the Market Place, the third behind Trinity Church, and the fourth in Whitefriars Gate, near the bridge over the docks.

The smaller lights are on lamp-posts, exactly similar to those used last year in the City of London, and are distributed over the principal thoroughfares at about 100 yards distance from each other.

The station is situated in the yard of Messrs. King & Co., South Church Side, and contains two 12-horse-power compound semi-portable engines supplied by Messrs. Wallis and Stevens, of Basingstoke, each of which is capable of working the street light alone. Suitable arrangements are also provided for measuring the currents, and for interchanging the machines.

The Town Hall is about 1,000 yards distant from the station, and the two circuits of the smaller lights measure 1,930 and 1,700 yards respectively.

The lighting was witnessed by a large crowd of people, who expressed themselves as very well satisfied with the result, and it will be continued for the next twelve months.

The contract has been carried out by Messrs. Siemens Bros. & Co., the work being done under the superintendence of Mr. F. W. W. Melhuish.

ELECTRIC LIGHTING AT THE ROYAL ALBERT DOCK.

As may be remembered, four stations have been erected in the dock, each containing a 20-horse-power condensing engine, supplied by Messrs. Marshall & Co., and a number of electrical machines. Some of these work the powerful arc lights suspended from tall latticed iron posts, and others, giving alternate currents, are connected with two main leading wires running along all the sheds on the north-side of the dock. At each shed a commutator is provided, so that the current can be turned into the shed or the shed may be cut out.

Specially constructed suspenders are suitably distributed over the interior, the front, and the back of the shed, to which the lanterns containing the electric lamps can be attached; provision is also made for connecting ships lying alongside the quay, by means of movable leading wires to the circuit, so that electric lights can be placed in the hatchways, and below, for facilitating loading and unloading during night-time.

As this mode of working has given universal satisfaction on the north-side of the docks, Messrs. Siemens have now received a further order from the dock company to fit up the sheds on the south-side in a similar manner, and the work is being pushed on with all speed.

METHODS OF EXCITATION AND OF AUTOMATIC CONTROL OF DYNAMO-ELECTRIC MACHINES.

THE method of excitation for the electro-magnets of the dynamo-electric machines ordinarily adopted is that for which we are apparently indebted to Hjorth. It is too well known to require a description, and we generally give it the name of surexcitation (mutual accumulation). The principle is applied, moreover, to all methods in which the electro-magnets are excited by the armature of the same machine. It is represented diagrammatically in fig. 1, and may be con-

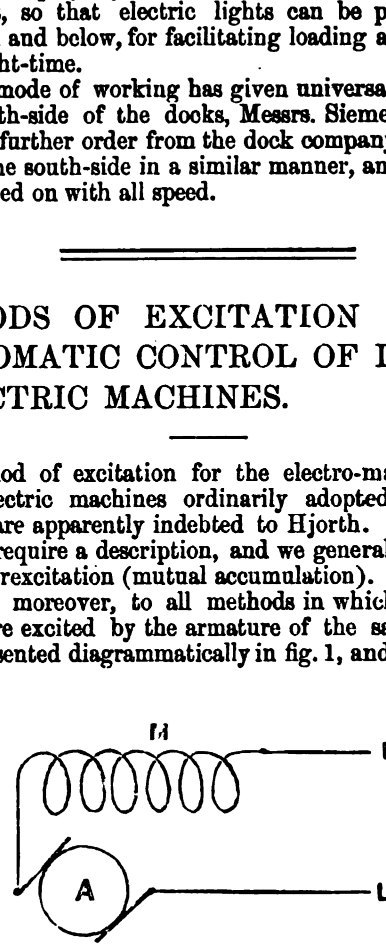


FIG. 1.

sidered in this investigation as the *ordinary* method; the electro-magnets, M, are in the same circuit as the armature, A. L, L[1], represent the terminals of the machine.

There is a prior method of exciting the magnets of the

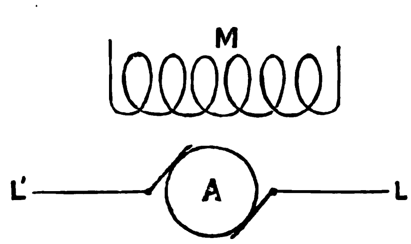


FIG. 2.

machines, which is due to Sinsteden (*Pogg. Ann.*, 1851, Vol. LXXXIV., p. 186). It consists of producing entirely, by an auxiliary machine, the current which circulates in the coils of the magnet; this is represented in fig. 2, but the auxiliary

machine is not shown in the drawing. This arrangement is still frequently employed, the regulation in the principal circuit or in the armature being brought about by the variation of the force of the exciting current coming from the auxiliary machine. Such a system necessitates the employment of a regulator to introduce resistances into the circuit of the auxiliary machine, or to remove them; it requires also a second machine, and constitutes a costly and troublesome arrangement in consequence of the complication of the apparatus.

Quite recently, M. Marcel Deprez has made known a combination of these two methods in a system remarkable for its simplicity, the facility of understanding it, and its numerous applications. M. Deprez has not only demonstrated that the theory of his combination is applicable to practice, but he has shown numerous and important applications of it.

This system consists (fig. 3) of coiling side by side, upon the inductors of the electro-magnet, two wires of equal diameter; one of the circuits is traversed by the current of an auxiliary machine, the other by the current which the armature of the machine itself produces in its rotatory motion. The first circuit is employed to maintain an "initial field," the second develops in the ordinary fashion the full power of the inductors. In order that the electromotive force may remain constant, it suffices to attain a certain speed; to maintain the intensity of the currents the inductors are arranged in a circuit derived from the principal circuit, and the same speed gives the desired result: however, in each case, the resistance of the exterior circuit may be varied.

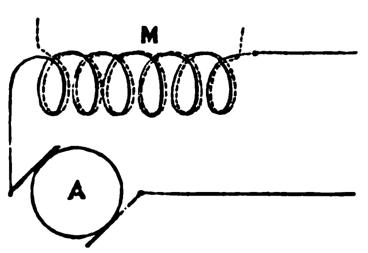


Fig. 3.

Thus, without any auxiliary apparatus, excepting an excitor, beside the ordinary dynamo machine, the system of M. Deprez presents a perfect mode of regulation, which, by the simple operation of a commutator, can maintain constant either the electromotive force or the intensity of the current, whatever the variation which is produced in the resistance of the internal circuit.

In December, 1881, this system was completely described in the columns of *La Lumière Electrique*; in the month of March of the same year I had applied for a patent at the United States Patent Office, which was granted in June, for an arrangement of the inductors of a dynamo machine allowing of obtaining the same results without any auxiliary excitation. It is scarcely necessary to add that my experiments had been made long before.

Before coming to the description of this system I would observe that Wheatstone, in an anterior memoir (1867), had proved the advantages of mounting the inductors in derivation, an arrangement which has only been recognised quite lately. Mr. Edison, without this manner of arranging his machines, would probably be still in the same position for the excitation of a low resistance machine as the greater part of the constructors of electrotyping machines who have not yet adopted this kind of mounting. This is, in fact, the only efficacious manner of mounting these machines. It is represented in fig. 4. From an historical point of view we can see that the great inductors now employed in the best constructed machines are evidently only an exaggerated imitation of the forms of machines designed and constructed by Wheatstone, and I can also affirm that, for him, this construction was not a matter of chance. Indeed, a number of ancient machines, witnesses of the most ingenious conceptions, are now presented as modern inventions. We ought even to include in this category the idea of the initial field, if we accept the description of Hjorth's machine (1854). We find there all the elements of the initial field, although the description is not sufficiently practical. In the specification which I presented to the United States Patent Office in March, 1880, but which I subsequently withdrew, I thought to obtain an initial field by introducing, amongst the other inductors of a machine, electro-magnets having portions of their cores of steel; but the great dimensions required to make sure of practical results and the inferiority of the steel which one could procure in America for this purpose, soon made me abandon this idea in favour of a combined system of electro-magnetic inductors.

I arranged this combination in the following manner: We chose, by preference, a dynamo machine bearing several electro-magnets to form each of the magnetic poles of the inductors. (Or, if it is a machine in which there is more than one pair of poles, the distribution will be made between the various series of magnets, as will be easily understood.)

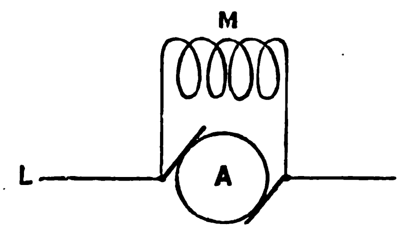


Fig. 4.

Some of these electro-magnets are included in a derivation between the poles of the armature of the dynamo machine, and the others are disposed in the principal circuit. The proportion of the distribution will vary according to the object and according to the electromotive force of the machine.

Fig. 5 is a diagram of the machine thus arranged. Fig. 6 shows a Bürgin machine so arranged.

By accepting the demonstration given by M. Marcel Deprez (*La Lumière Electrique*, Vol. VI., p. 309) as applying to this case, although, in consequence of the introduction of another variable, the integration can only be made by a fraction, we see that we have an initial field formed by the

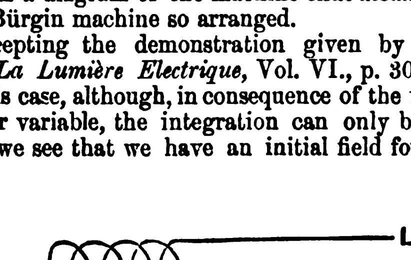


Fig. 5.

magnets of the derived circuit, and it is easy to find the speed for which the difference of potential in the principal circuit ought to remain constant, notwithstanding variations of resistance. But the variation of speed necessary to establish this condition will alter the initial field, and, consequently, will modify considerably the analytical solution of the problem.

However, in practice, a system of conical pulleys offers a simple solution to the question of the determination of the speed. By referring to the diagram employed by M. Marcel Deprez, and remembering that in this case diminution of speed signifies decrease in the quantity of the current which produces the initial field, as well as in the potential corresponding to this quantity of current, we can easily understand that it is necessary to have some other series of determinations of the electromotive force corresponding to the varying intensity of currents, and this is the only practical difficulty which must be first surmounted by the manufacturer of a machine for finding the suitable speed.

If the inductors are arranged in such a way as to comprise in one circuit all those which correspond to the north pole of the machine, and in another circuit all those which give the south polarity, a curious state of things is brought about.

We know that if one pole only of the inductors of a dynamo machine be excited there is practically no current, and that if we excite the poles unequally we do not obtain all the power of current which we should have by an equal excitation of the two poles; it is easy to see the reason. Let us suppose now that we arrange our derived system of inductors to have a certain magnetic field produced by a certain quantity of current and a certain number of turns of wire in the inductors; if the magnetic field corresponding to the other pole and to the other circuit is not maintained, or nearly so, at the same intensity, the current furnished by the machine will have practically disappeared. That is to say, that one can construct on this principle a machine which will give a current only when the external circuit is in a normal condition; it is unnecessary to insist upon the enormous advantages which one can derive in certain circumstances from this possibility without the help of any kind of auxiliary.

derivation upon an ordinary dynamo, one introduces into the principal circuit a magneto-electric machine, or a battery producing a constant electromotive force equal to that which should exist between the auxiliary and the outgoing and return wires of the principal circuit. The speed of the dynamo machine ought to be such that the electromotive force produced may be proportionate to the current which circulates in the inductors, or, in other words, as the field in which the armature moves, or proportional to the magnetising current. When a dynamo mounted in derivation is employed Professor Perry prefers to place the magneto machine in a part of the circuit completely outside of the machine, that is to say, in the principal circuit, in such a manner that the current passing through is that which goes to the supply cable.

These arrangements are suitable when the lamps are arranged in derivation; when the lamps are in series a dynamo machine is employed in derivation, and a magneto-electric machine. If we call M the portion derived from the dynamo, and A the circuit from the armature, the two ends of A and of M are similar, and may be called the terminals of the machine. If these terminals are connected to the two ends of a circuit containing a series of lamps, and a

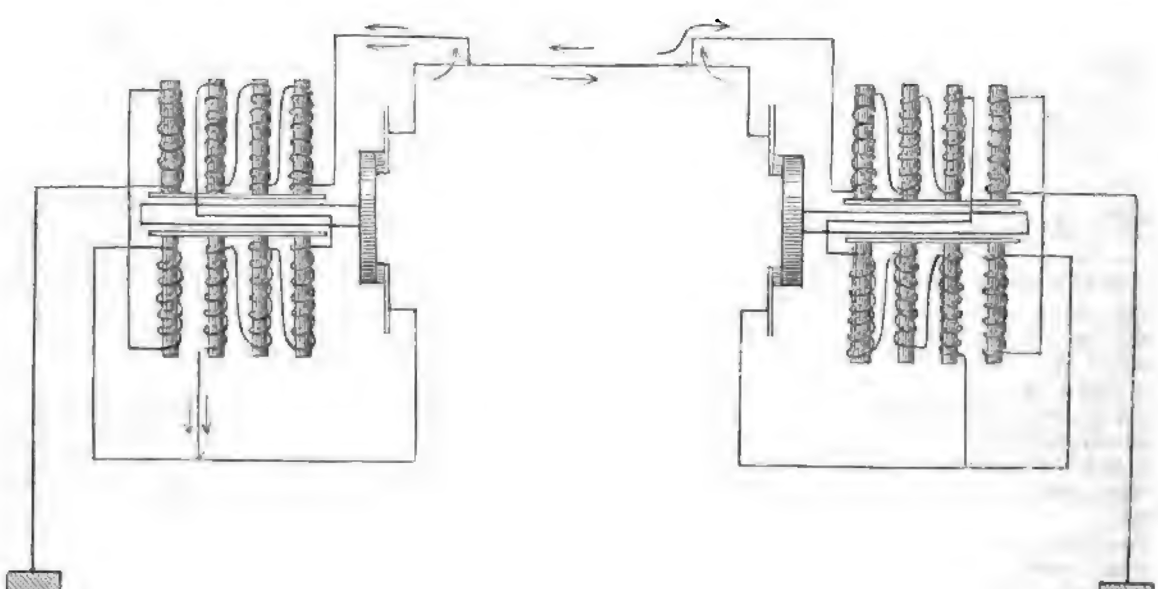


Fig. 6.

magneto-electric machine is introduced from the side A or from the side M, or even if we have one magneto-electric machine in A and another in M, we can impart to the machine a speed capable of making it produce a constant current of electricity through the external circuit, whatever variations the resistance may give.

The constant current is that which the magneto-electric machine or machines would produce in a circuit of which the total resistance is equal to the resistance of A.

There, are thus, three methods of absolute regulation which are offered to electricians—that of M. Marcel Deprez and that of Professor Perry, each requiring an auxiliary machine or the equivalent; then that which I have just explained myself here, and which requires only one machine to obtain practically the same result.

By reviewing these inventions I put formally aside all desire of claiming a priority, even if it is due to me; for I am persuaded that the process which is most practicable will procure at the present day the best recompense to its inventors; besides, each of those which have been described possesses its advantages.

I reserve for a future publication a more profound study of this question.—*Paget Higgs, in La Lumière Electrique.*

Besides the advantages either for lamps, or for motive engines actuated by a machine which is arranged according to the combined principles of derivation and of a primary inductive circuit, each lamp or motor is absolutely independent of its neighbour in the same circuit, so much so that one can extinguish the one or stop the other, light up again and put in motion without any influence upon the others. There is yet another benefit. Whoever has manipulated the large dynamo machines set up according to the ordinary plan must have experienced a continual anxiety, when they were moved by an engine having very little surplus power, as to what would happen if the circuits were suddenly and completely severed. A very serious accident happened to me under these conditions, and the result was the almost complete destruction of the motive engine, for the regulator could not follow the lightning rapidity of the electric current. In the case of the combined system the charge is never completely suppressed, and the motor, slightly weakened, soon comes to a standstill. The same cause of danger is encountered with the simple system of derivation employed alone when the external circuit is short-circuited, or when a lamp ceases to act.

A method for the distribution of electrical energy has been recently patented by Professor John Perry. It consists of combining with the dynamo machine one or several magneto-electric machines or other sources capable of producing in a circuit a constant electromotive force independent of all the other electromotive forces which are found in the circuit. When the principal wires are arranged in

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CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE INTERNAL RESISTANCE OF BATTERIES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Will you, or will some of your correspondents, be so kind as to inform me, through the columns of the Review, how I can accurately measure the internal resistance of a cell (say a Daniell) by Mance's method on the slide-wire Wheatstone bridge? My bridge has a scale-reading of one metre, and is made like that described on page 135 of Kempe's "Handbook of Electrical Testing," new edition. I would be glad if you would give a diagram or figure of all the necessary connections, and work out an example. Should Mance's method not be a desirable process for the slide-wire bridge, please give one that is desirable, and oblige,

Yours, &c.,
SAMUEL PURNELL.

San Francisco, California, U.S.A.,
September 11th, 1882.

[An answer to our correspondent will be found on page 276.—EDS. ELEC. REV.]

THE RESISTANCE OF CARBON AND LIGHTNING PROTECTORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The article in your journal of August 19th, which contains some extracts from a paper of mine published twelve years ago, has elicited two communications of practical interest from Mr. Haynes, and an angry growl from another correspondent, who accuses me of "reinventing and rediscovering old things," and suggests that "the world must be coming to an end" because what he evidently would have preferred to be considered dead has been proved to be still alive.

Resurrections are not always convenient, and I suspect the real offence in the eyes of my critic consists not so much in my having invented the "Lightning Bridge" as in the demonstration by Mr. Haynes of its efficiency as a lightning protector. My adverse critic, however, has omitted one thing in his communication, and this omission happens to be the only thing which could possibly have given any value to his criticism: the letter is published without his name, and the only reply I have to make is "denunciation is always easier than suggestion as criticism is easier than creation."

Mr. Haynes informs us that he has 110 instruments protected by lightning bridges, that 73 of these bridges have been in use for fifteen years, and 33 have been doing duty for twelve years. He tells us, further, that not a single case has occurred during the whole of this time of an instrument so protected being damaged by lightning. Can any practical engineer who has had the charge of telegraphs say as much as this of any other form of lightning protector?

I do not know whether Mr. Haynes has had any experience of plate protectors, which were so much lauded by Mr. Preece in a paper read before the British Association meeting of 1879, and to which he referred as an example of "the survival of the fittest;" but there must be amongst your numerous readers many who have had experience of this form of protector, and it would be interesting if they would inform us of their behaviour in practice, whether cases have occurred of coils being fused when so protected, and whether a lightning discharge does not very frequently short-circuit the instruments.

Mr. Haynes in his second communication states that many cases have occurred where the resistance of the bridges has been so reduced by the effect of a lightning discharge as to practically short-circuit the instruments, their efficiency, however, being immediately restored by "a slight tap" on the lightning bridge; and he asks whether a similar effect has been observed in powdered carbon telephone transmitters.

The currents employed with telephones are of low potential, and the effect noticed by Mr. Haynes is only produced by the passage of currents of very high tensions. If he refers to the first page of your article of August 19th he will find what I believe to be a correct explanation of the effect noticed.

Whilst on this subject I may say a few words on the action of the carbon transmitter of a telephone. I see in a paper read before this year's meeting of the British Association by Mr. Preece the action is attributed to the reduction of the resistance of the carbon at the points of contact by the passage of the electric current developing heat.

Some experiments which I have tried do not seem to me to support this view. Carbon absorbs moisture certainly, when in the form of powder, and probably to a more or less extent in all its forms. Polarisation of this moisture occurs when the circuit is closed, and this effect is very apparent in the case of powdered carbon which has been kept in a damp room.

I may mention that the temporary short-circuiting observed by Mr. Haynes in my lightning bridges after lightning discharges will be found, I believe, to be almost entirely obviated in the later construction of these protectors. The body of the protector in the newer form is a chamber of metal, which is connected directly with the earth. Three pointed conductors approach one another in the centre and are surrounded with carbon powder; one of these points is connected to the frame and the other two are insulated, and are connected to the two ends of the insulated wire forming the coils of the instrument. In this construction, therefore, there are three courses open for the lightning discharge: the lightning can effect its discharge by leaping a short space of air, without passing through the powder at all, or it may pass through the powder directly to earth, or across the powder through the insulated conductors. In practice, I believe, it will be found that the greater part or the whole of a heavy lightning discharge will take place outside the protector, whilst the secondary discharge arising from the line wire passing from the magnetised to its normal condition, and which I believe I have demonstrated to be the current which fuses the coils, will pass from one of the insulated conductors through the carbon powder to earth direct.

My bridges were introduced in 1866, and at the time my paper was read at the meeting of the British Association in 1870 upwards of 1,000 of my bridges were doing duty, and not a single case had occurred of a coil being damaged when so protected. Cases, however, occurred in which lightning discharges destroyed the bridges altogether, burning up the powder and fusing the conductors; but the percentage of these cases compared with the number at work was very small. After the reading of my paper the Postal Telegraph Department adopted my bridges for protecting the local circuits, and, speaking from memory, some 7,000 or 8,000 were fitted. A violent lightning storm occurred in the metropolis some time after this, discharges of lightning taking place almost continuously, melting the gas pipes and setting fire to the gas in more than one office. I was informed by the postmaster of one of these offices that there was a noise like the continuous cracking of whips during the time the storm was raging.

The effect of this certainly abnormal storm was to destroy some of the bridges, and on this, which I cannot but consider insufficient ground, the Postal Telegraph Department discontinued using them.

S. ALFRED VARLEY.

2, Hamilton Road, Highbury Park, N.

AKESTER'S ARC LAMP.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In my preliminary report upon Akester's arc lamp, the figure of performance should be 1,500 candles per electrical horse-power, not 500. The exact figures for an elevation of 30° were: for red light, 1,343 candles; for green light, 1,838. The mean of these values is 1,560·5.

I am, yours faithfully,
SILVANUS P. THOMPSON.

October 3rd, 1882.

TELEPHONIC COMMUNICATION WITH DIVERS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In reference to a notice which appears in your journal under the above heading, I should like to say, if you consider the matter to be of sufficient interest, that, shortly after Prof. Graham Bell came over to this country bringing his now well-known telephone, I had the pleasure of carrying out some experiments, in conjunction with Prof. Bell, in consequence of my suggesting the application of the telephone to diving operations.

The telephones were constructed, under my superintendence, at the works of Messrs. Siebe & Gorman, and the experiments were made in the diving tank of this well-known firm.

These experiments were referred to by Prof. Bell during his lecture at the Society of Arts, Adelphi, and the fitted helmet was exhibited by him to the audience.

I am, Gentlemen,
Your obedient servant,
S. ALFRED VARLEY.

2, Hamilton Road, Highbury Park, N.,
October 3rd, 1882.

THE LANE-FOX INCANDESCENT LAMP.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—At the general meeting of shareholders of the Devon and Cornwall (Brush) Electric Light and Power Company, as reported in your journal of the 9th ultimo, a shareholder inquired of the chairman why the directors issued the prospectus stating that they had purchased the *exclusive* right to use and sell in Devon and Cornwall the "Lane-Fox" incandescent lamp, seeing that he had ascertained that a prior licence was registered at the Patent Office in favour of the British Electric Light Company.

The Chairman in his reply said, as reported by you, *That unless the directors really supposed that they had such exclusive right they would not have issued such a statement. The Company did not know of anything to the effect that they had not the exclusive right. If a fraud had been committed upon them by the sellers they had their remedy."*

The shareholder (Mr. Tyler) said he thought the answer given extremely unsatisfactory; and so do I. Whether a fraud has been committed or not, there can be no doubt that the directors must have been, to say the least, extremely negligent in not ascertaining that so important a part of their prospectus was true or the contrary.

In my letter, which appeared in your number of the 16th ult., I supplied the information which the Chairman did not—that the prior full licence to the British Electric Light Company is still in force throughout the United Kingdom.

It is dated the 27th July, 1881, and can be seen by payment of a shilling at the Commissioners of Patents Office, Southampton Buildings, Chancery Lane, on applying for the records relating to the Lane-Fox Patents, Nos. 3,988, 4,043, and 4,626, of 1878. It stands at the head of the list of agreements relating to the patents, and is followed by an assignment from Mr. Lane-Fox, of a later date, to the Anglo-American Brush Corporation, in which the British Electric Light Company's previous general licence is specially referred to and excepted from the operation of the assignment.

Since I wrote the letter in question, I have referred to the Devon and Cornwall Company's prospectus, and I find it there stated that the directors have acquired the *sole right* to use and sell in the Counties of Devon and Cornwall all the Brush patent dynamo machines, lamps, &c., and the Lane-Fox incandescent lamp, in consideration of £19,750, out of a nominal capital of £100,000. But I find that this is a mere fragment of the operations of this character.

The directors of a single company might be ignorant, through carelessness, that they were inviting subscriptions upon a false statement and paying a large amount of the shareholders' money away in connection with it; but the case becomes yet more serious when it is found that this procedure has been systematic; for I find that nearly the same words (untruly alleging the acquirement of these exclusive rights) were embodied in the prospectuses of the following companies:—

The Great Western Electric Light Company, Limited; The South Eastern (Brush) Electric Light and Power Company, Limited; The Brush Midland Electric Light and Power Company, Limited; The Birmingham and Warwickshire (Brush) Electric Light and Power Company, Limited; The Staffordshire and Worcestershire Electric Light and Power Company, Limited; The Yorkshire Brush Electric Light and Power Company, Limited; The Brush Electric Light Company of Ireland; The Brush Electric Light and Power Company of Scotland.

Perhaps this list might be added to. Some of these exclusive rights profess to be sold by the Anglo-American Brush Corporation; others by the Hammond Electric Light and Power Supply Company, Limited, to whom the former company sold some licences, as can be seen at the Patent Office.

Some of the Directors of the Brush Company went on the Boards of the affiliated companies. I also find, which appears to me remarkable, that the solicitors to the Hammond Company are also solicitors to four of the companies enumerated above. I remember many cases in which shareholders have recovered from directors and vendors the money which they had been induced to invest by false statements held out in prospectuses, and I am surprised that the chairman of the Devon and Cornwall (Brush) Electric Light and Power Company did not frankly agree to the request of the shareholder who asked for a committee to inquire into the truth of the grave allegations made by him on this subject.

Yours faithfully,
CHARLES T. BRIGHT.

31, Golden Square, London, W.,
October 3rd, 1882.

G. W.—Your suggestions shall have due consideration at our hands.—[EDS. ELEC. REV.]

NOTES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—On the third day of meeting Prof. Putman, the permanent secretary, announced that 227 papers had been entered. Dr. J. W. Dawson, Montreal; Prof. F. W. Clark, Cincinnati; Dr. Edward S. Dana, New Haven; Prof. H. W. Martin, Baltimore; Prof. C. A. White, Washington, were appointed a committee to confer with the British Association on the annual records of science. The following committee was appointed to confer with committees from foreign associations for the advancement of science, with reference to an international convention of scientific associations, viz.:—Dr. T. Sterry Hunt, Montreal; Prof. Alex. Agassiz, Cambridge, Mass.; Prof. Simon, Newcomb, Washington. Immediately on the adjournment of General Session, Section B met in the William Molson Hall for the purpose of hearing an address by Prof. Alexander Graham Bell, upon "The Electrical Experiments to determine the location of the bullet in the body of the late President Garfield, and upon a successful form of induction balance for the detection of metallic masses embedded in the human body."

Prof. Bell said that the subjects of his lecture recalled a time of intense excitement among the American people. In the dread of the barbarous method of knife and probe in discovering the hidden bullet, he and other scientific men in the States cast about for some less painful means. The telephone naturally suggested itself as a means of doing this in connection with the ordinary induction apparatus invented by Prof. Hughes, of which the principle is the neutralising of the action of one set of coils by the reversed action of the second. Prof. Roland, by the action of the galvanometer, modified this induction apparatus, and this was afterwards improved by other inventive scientists. The lecturer himself, when the news of the assassination flashed through America, had just invented an induction apparatus, consisting of two flat coils of wire, superimposed on one another. Prof. Newcomb thought the presence of the bullet might be indicated by the retardation of a magnetic needle caused by the lead. The lecturer offered to make any experiments necessary, and Prof. Newcomb requested that he would discover whether the presence of a leaden bullet would deflect a magnet needle suspended over it. He applied the principle of the induction balance, and was astonished at the instant effect upon the needle, the bullet being placed about an inch from it. In the ordinary induction balance the influence of the bullet was not manifested at any distance, and the task was now come to construct

a balance which could overcome this difficulty. The best theoretical arrangement of coils for an exploring machine was learned from different sciences. The coils, when made and tried, were, however, no better than the first, being extremely sensitive to a piece of lead within the helix, but with a hearing distance of only about an inch and a half. After trying all sizes of coils from one of the size of the bullet explored for, and using battery-power varying from one to twenty Bunsen cells, the hearing distance of the bullet remained about the same. It was then determined to proceed empirically to discover the necessary coil. An instrument was made in which a brass ring was used instead of a leaden bullet, and, under different conditions, the hearing distance increased with the diameter of the primary, but the maximum effect was gained when a secondary coil was placed outside the primary. This led to the idea that the primary should be larger than the secondary, and, acting on this idea, a new instrument was constructed, the hearing distance of which was five centimetres. On the 22nd July, 1881, an experiment was made, by the request of Dr. Bliss, on the person of Lieut. Simpson, who had carried a bullet in his back for a number of years. A sonorous spot was found. The results were communicated to the President's medical attendants, and they decided that an experiment should be made on the person of the President on July 26th, 1881. Prof. Knowland suggested before this, however, the addition of a condenser to the circuit, and by this means a distinct whistle was heard when the apparatus was placed near a piece of lead. The results obtained at the experiment were as follow:—The telephone gave a peculiar spluttering sound, which could not be lessened by any arrangement of the coils. Passing the apparatus over the lower part of the right side of the President's abdomen a sudden increase of sound was heard, but a repetition of the operation failed to verify this. Owing to the faulty adjustment of the condenser the experiment was not a success. The condenser was improved and the apparatus tried successfully upon several old soldiers who were wounded in the civil war. Flattened coils were afterwards used, and by this means a hearing distance of 12 centimetres, or five inches, was obtained. The two coils were placed in a wooden handle, and a clearly-marked sonorous spot was easily discovered on the body of a wounded soldier. With this apparatus a second experiment was made on the body of the President. The instrument was now so sensitive that a pulsation was secured at two elevations upon passing it over the body of the President. An area of sound was discovered, and it led to the idea that the bullet was within this area, which was afterwards found to be incorrect. This area of sound was produced by a steel wire mattress under the President's bed, a fact which had been overlooked by the President's physicians. The apparatus was afterwards improved by embedding the two ends in paraffine as nearly as possible in a position of silence, the slight residuum being overcome by the smaller coil connected with the larger one and adjusted by a micrometer screw. With this a successful experiment was performed on the body of Colonel Clayton, who had suffered for several years from the presence of an Enfield rifle bullet. The apparatus was subsequently modified in form for purposes of convenience, and now the exact position of a bullet in any part of the human body could be accurately determined. The results may be regarded as giving promise of still greater possibilities in the future. The work in this direction, the writer concluded, had been merely a matter of love, and he could not have had a higher inducement than to alleviate human suffering.

At the conclusion of Prof. Bell's paper, an unanimous vote of thanks was passed.

The vice-president, Mr. T. C. Mendenhall, of Columbus, O., afterwards communicated a paper on the reduction of the electrical resistance of the carbon button by the passage of an electric current, in which he gave a description of experiments for the determination of this resistance, showing that the resistance is lowered by the passage of a current of electricity.

Among the other papers read in this Section were two by A. E. Dolbear, "On the Construction of Magnets," and "On Electrical Conduction *versus* Induction."

In the Mathematical and Astronomical Section Professor Pliney Earle Chase, of Howerford College, Pa., read a paper "On the Conservation of Solar Energy."

All forms of solar energy, he said, are due to solar radiations. The maintenance of their energy, therefore, depends on the maintenance of the radiations. Every solar particle is continually solicited towards different nodal centres of gravity. Hence arrive cyclical oscillations, representing the results of equal actions and reactions, in which the particles alternately recede and approach the several centres of gravity. The nodal action of centres of gravity is accompanied by an unstable equilibrium of the sun's photosphere, in consequence of the photodynamic equality of luminous and gravitating oscillations which tend to drive all the particles towards the limits between aggregations and dissociation. Berthelot's investigations of explosions of gaseous compounds by detonating agents have indicated the existence of explosive waves, which are quite distinct from waves of sound, and have shown that compounds and explosive mixtures generally become non-sensitive to shocks as they near the temperature at which they begin to decompose or combine. Hence a meteor, or even a single molecule, which has acquired a sufficient velocity of subsidence in its downward fall, may explode a gaseous compound which is in, or near its nascent state, and the explosion may react upon the falling mass or molecule, so as to leave it in a state of unstable equilibrium which is ready for explosion by the next like subsidence. The particles which are repelled to Laplace's limit, as Siemens has shown by the centrifugal force of solar rotation, yield a mechanical equivalent of 152,000,000 T for every pound of matter that subsides to the poles. The spiral character of the subsidence gives rise to Amperian currents, which account for Maxwell's identification of luminous and electro-magnetic waves.

ON the 28th August, after a brief respite, the Congress resumed deliberations. After electing a number of new members, paying a tribute to the late Charles Darwin, disposing of Committee Reports and Requests and other formal business, the various sections met and discussed the numerous papers submitted to them. The following extracts are from those papers most likely to interest our readers:—

Professor C. S. Hastings, the Secretary of Section B., read a paper on certain complex flame spectra of sodium. Mr. Hastings described methods by which the well-known double sodium line shown by sodium vapour in a Bunsen burner may be made to appear as constituted by any number of lines from two to eight. He also called attention to a possible explanation of certain close double lines in the solar spectrum.

Mr. Brown Ayres, of the University of Louisiana, New Orleans, read a paper on some phenomena of diffraction due to the shape of the source of light.

Light from a source of different dimensions in directions at right angles to each other is allowed to pass through a square mesh wire gauze. The phenomena observed on a screen placed beyond the gauze is peculiar. Shadows parallel to the longer dimensions of the source of light are observed with little or no shadows at right angles to them. An imperfect image of the wires of both sets is seen in rotating the source of light through an angle of 45 degrees. A blurred appearance is sometimes all that there is of this phenomena. A diffraction phenomenon of great beauty is produced by passing sunlight through a cylindrical lens and then through the square mesh gauze. The disturbing action of the apparent diameter of the source of light as seen from the gauze causes the disappearance of the shadows in the plane perpendicular to the cylindrical lens. The mathematical theory of this phenomenon is of the greatest complexity and difficulty. At a moderate distance from the gauze the appearance is that of a brilliantly coloured striped cloth. Farther away the regular spectra are seen within and without the geometric shadow of the urries.

Prof. Edwin H. Hall read a paper on the "rotational coefficient" in gold, iron, &c. The paper observed that the rotational co-efficient in gold is affected but slightly by change of temperature, if affected at all. In iron it is strongly affected, while the co-efficient is increased by tempering. The permanent magnetisation of steel effects a rotation.

SECTION A.

THE NATURE OF COMETS.

The first paper read in this section was by Prof. P. H. H. Vander Weyde, of Montreal, on "Some Suggestions on the Nature of Comets, with recent Astronomical and Electrical Discoveries."

That comets consist of clusters of solid bodies floating in space has been made highly probable by the connections traced between them and meteoric showers, while it is not contrary to telescopic and spectroscopic observations. The question arises as to what keeps their masses separate and prevents them from obeying gravitating attractions and falling together into one mass in their common centre of gravity. The recent revelation about the behaviour of what Crookes calls matter in the fourth state, under the influence of electric currents, and of the latter in vacuum tubes, and especially when acted upon by magnetic repulsion or attraction; also the consideration that a real vacuum is the best of all non-conductors,—all this suggests that the force which keeps the separate bodies constituting a comet apart may be a permanent electric charge, which cannot escape from the interplanetary medium, and is a good conductor. We can even imitate such an action in the air with a bundle of suspended light bodies, charged with static electricity. Such electrically charged clusters must be acted upon by the sun. The practical experiments with Crookes' tubes, and the actions upon them of magnets and bodies charged with static electricity, also suggest how the sun, which may as well exert electric as magnetic action, can cause changes in comets, and regulate the development of their tails, which always manifest a solar repulsion, very analogous to the repulsion by magnets of the luminous streams in vacuum tubes.

Mr. Winslow Upton, of the Army Signal Office, Washington, read a paper on "The Spectroscopic Rain-band."

Considerable attention has been bestowed on the variable lines in the spectrum due to atmospheric causes, especially to those due to the presence of aqueous vapour, which have been studied by Janssen, Secchi, Smyth, and others. These vapour lines vary with the amount of aqueous vapour, and hence can be taken as furnishing a measure of the amount present at different times. Regular observations have been made by myself with a Browning pocket spectroscope. The results obtained may be summarised:—

1. The rain-band is of value in estimating the amount of moisture present in the atmosphere.

2. Its indications follow in general those of psycerometer, but have the advantage of showing the moisture present in a large portion of the atmosphere, which advantage is occasionally of use.
3. It is of some use in foretelling rain, but must be used as any hygrometer and not as an infallible independent of other conditions.
4. Improvements in the instrument used are needed to increase its efficiency before it can be regarded as a meteorological instrument.

Prof. A. E. Dolbear then read a series of papers discussing electrical questions. The first, entitled "Electrical Conduction *versus* Induction," was a comparison of the phenomena exhibited in both these branches of the science. The broad conclusion deduced by the lecturer was that electricity was conducted by matter and not by air. The other papers were on the telephone as an explorer in an electric field, on vortex rising phenomena, and on telegraphing without wires.

Mr. Stephen S. Haight read a paper on "Danger from Lightning Increased by Telegraph Wires."

Last year he had seen a house struck by lightning and the eave-plates completely shattered. No other damage was done to the house, and the family experienced no evil effect more than a slight shock. At each end of the house was a lightning conductor, and those rods bore no marks. In front of the house was the pole of a telegraph line, which was stayed to the gate-post by a wire. This wire was melted, the gate-post uncased, and the gate itself broken. A deep furrow also ran from the gate to the brick sidewalk, where it ended in a deep hole. A tree in the course of the furrow was circled by the fluid and killed. Between this and the house no effects were visible, and the sole injury to the house itself was the destruction of the eave-plates. There was no doubt that the damage was caused by the stay wire, and that the hemlock trees attract the lightning more than deciduous trees.

Mr. George F. Barker read a paper on "Secondary Batteries." Much attention is now directed toward the cheapest possible method of producing electricity for the purpose of electric lighting. In this effort much time and study has been devoted by scientists to the devising of the best form of secondary battery, and the lecturer gave a brief account of experiments and research conducted by himself in this direction, with the object of discovering some method for facilitating the reversal of the electromotive force in batteries of this kind.

The thirty-first annual gathering of the American Association for the Advancement of Science was brought to an end by a complimentary excursion to Newport and Lake Memphremagog, given by the South Eastern Railway Company. The weather was fine and a most enjoyable day was spent. On returning to Newport hands were shaken and friends parted with the words, "We will not meet again until we assemble at Minneapolis."

THE ELECTRIC LIGHT IN WAR.—We have received information that the British Electric Light Company has just taken in hand an order from the Admiralty to supply the following search light apparatus for war vessels: eight large "Gramme" machines to produce a light of 40,000 candles each, eight projectors, and eight hand lamps, as used in the late war.

ANOTHER EXHIBITION.—Another exhibition of electric and gas lighting is, we understand, to be held in St. James' Hall on December 11th next. Full particulars may be obtained from Mr. E. J. Cowlings Welsh, C.E., Palace Chambers, St. Stephen's, Westminster.

THE LATEST DISCOVERY IN DYNAMO MACHINES.—Assuming, says the *World*, that the *Times* has discovered a new dynamo-machine, how will the discovery affect existing companies and their little ones? We should like to know that. It has long been our private opinion that these companies had started long before their time with "patents" most patently worthless, because the force they were trying to utilise was as yet but imperfectly under control, and the means of producing it but crudely developed. If the new machine which the *Times* says Sir William Thomson has patented is one-fifth the cost and much more efficient than any existing machine, companies which have no share in this invention will be in a bad way. But then next week somebody may distance Sir William Thomson; for he is not the exclusive electrical phenomena producer now living, by no means, and another inventor may devise a simpler lamp than any one knows of, with the result that the speculators, now in the full blaze of success, will in turn pass into oblivion. Where are we in this electric lighting and generating business, in short? Immense fortunes are about it somewhere, but hitherto they have been the promoter's fortunes only, and all we can see in this new machine at present, is a new crop of this, unless, indeed, the public be sick of the business.

ELECTRIC LIGHTING.—A portion of the interior of Windsor Palace is about to be illuminated by electricity. The preparatory operations are progressing.

ON Wednesday week the Emperor and Crown Prince of Germany drove along the Leipziger Strasse, Berlin, to inspect the electric lighting of that thoroughfare. Both expressed themselves as highly pleased with the effect.

THE Cowpen Local Board, at a meeting held last week at Waterloo, Blyth, resolved to memorialise the Board of Trade not to grant a licence to any company to light the district with the electric light. There was one dissenting vote.

THE electric light now irradiates the streets of Hull.

Two electric lighting companies having notified to the Elgin Town Council that they purposed applying to the Board of Trade for a Provisional Order to supply the electric light within the jurisdiction of the council, that body has appointed a committee to look after the matter.

THE Aberdeen Gas and Lighting Committee had under consideration last week no fewer than six circulars, from as many electric lighting companies, giving the necessary notifications of their intended applications for powers to supply the granite city with electricity. After deliberating for some time the Committee decided to remit to their Town Council the question, "Should they themselves not ask for a Provisional Order?"

At the Town Council-meeting on Monday the Clerk said the Town Council had received notices from the six following private companies of their intention to apply for Provisional Orders to authorise the supply of electricity within the district of the Town Council as local authority:—The Pilsen-Joel and General Electric Light Company, Limited; the Edison Electric Light Company, Limited; the Swan United Electric Light Company, Limited; the Hammond Electric Light and Power Supply Company, Limited; the Brush Electric Light and Power Company of Scotland, Limited; Messrs. Walter, Webb, & Co., solicitors, London. Notice of the following motion was given:—That the Town Council resolve to apply to the Board of Trade for a Provisional Order under the Electric Lighting Act, 1882, to authorise the Town Council as local authority under the said Act to supply electricity for any public or private purpose within the area or district of the Town Council as local authority under the said Act. After some discussion it was agreed to meet specially on the 6th November next and dispose of the question.

THE Kintore Town Council are the recipients of a couple of letters asking their concurrence in applications about to be addressed to the Board of Trade for powers to supply electricity to their burgh.

THE great Brooklyn bridge, which was begun in January, 1870, is slowly nearing completion, its opening for foot-passengers and vehicles being promised before the close of this year. It is intended that it shall be lighted at night by the electric light.

AT the Fine-Art Exhibition, which opens at Dundee to-day, there is to be a display of the electric light "on a scale and with a completion never before attempted in Dundee."

A FEW weeks ago we announced the withdrawal of the Maxim light from the Edinburgh General Post-office. We now learn that there is a prospect of the "Brush" getting a trial there. The lighting of a number of the shops in Princes Street by the local company is also contemplated.

THE electric light at the Munich Exhibition has been pronounced a great success.

THE Town Council of Salisbury are not likely to oppose the application of the Edison Company to the Board of Trade for powers to supply their town with light.

THE press rooms of the *Toronto Mail* are now lighted by electricity.

Eight companies have given the Birmingham Town Council notice of their determination to apply for Provisional Orders or licences to supply Birmingham with electricity. The Town Council are to consider the propriety of applying for a Provisional Order.

The electric light was introduced to Cambuslang on Tuesday evening last.

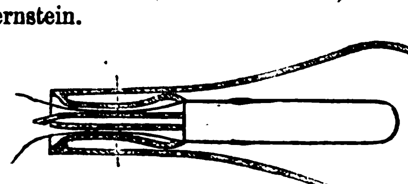
At the monthly meeting of the Banff Town Council, on Monday, notices of applications by the Brush, Hammond, and Swan companies for Provisional Orders to the Board of Trade were submitted. The deliverance of the Council was that they find they are not at present in a position to give consent to any of the companies.

The Berwick-on-Tweed Town Council have received the obligatory notice from several companies.

The Gülcher Electric Light Company.—On Tuesday evening last we paid a visit to the London Hospital, at the invitation of Mr. Charlewood, the secretary of the above company, for the purpose of inspecting an installation of the Crookes' incandescent electric lamps. These were burning during a conversazione which took place on the previous night, and had been pronounced a great success by the assembled company. In the dissecting room, which was gaily decorated and which was for the time devoted to more pleasurable scenes, were 40 incandescent lamps, arranged in 10 clusters of 4 each. These were supplied with the electric current from a Gülcher dynamo-electric machine, recently made by Messrs. Ransome & Co., of Chelsea, in whose premises it will be remembered the Gülcher system was first exhibited in England. This machine, which was constructed to supply 160 such lamps, was driven by a 14-horse-power nom. steam-engine, manufactured by Messrs. Ransome, Head, and Jeffries. The Gülcher system has already been fully described in the pages of the Electrical Review, so that it is quite unnecessary to say more concerning this part of the installation. The Crookes' incandescent lamp differs from others, we believe, in the details of construction only; it being claimed that the vacuum is more perfect, the carbon filament purer and more dense, and that the methods of manufacture render their production less costly.

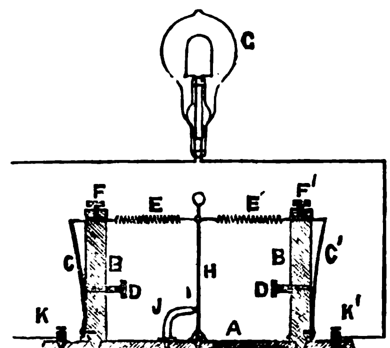
Instead of using platinum leading-in wires, Mr. Crookes employs a compound wire having a core of copper, and a sheathing only of the former very expensive metal. The filament of carbon is shaped very much in the style of the "Maxim," and the bulbs take the shape of large test tubes, instead of bulging out into the globular form. The Warden of the Hospital, to whose courtesy we are indebted for any information we required, expressed a hope that the time might come when that vast building would be entirely lighted by electricity in the place of gas. For such establishments, of course, its advantages strike one much more forcibly than in the case of ordinary households, although there it is most desirable. The general effect of the lamps was extremely good, and it is probable that had not the arrangements with the Gülcher Company been made at the last moment, the dynamo-electric machine might have been worked to its full capacity of 160 lamps. We may mention that the above company are the possessors of Mr. Crookes' various patents for incandescent electric lighting, for as this is one of the most recent lamps, the fact may not be generally known.

Electric Lamp.—Patent No. 263,011. Filed in the United States of America Patent Office, March 16th, 1882, by A. Bernstein.



Claim.—In an electric vacuum-lamp based on the principle of incandescence, the combination of a glass globe or bulb, a stopper sealed to the neck of the same and having a central evacuating-tube, and of conducting-wires which pass through the stoppers at the upper part thereof, the stopper being made of thin glass throughout and enlarged at the upper part, whereby nearly the same temperature is obtained in the upper part of the stopper as at the interior of the bulb, and thereby cracks and leakage prevented, substantially as and for the purpose set forth.

Safety Device for Electric Lamps.—Patent No. 262,423. Filed in the United States of America Patent Office, April 24th, 1882, by John H. Irwin.



Claim.—1. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, consisting of a spring having a resistance equal to the normal resistance of the circuit, adapted and arranged to be thrown out of circuit by another spring when the resistance of the main circuit is abnormally increased, substantially as described.

2. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, consisting of the springs, E E', rod, H, having a contact-piece, and the arm, J, with electrical connections, substantially as and for the purpose set forth.

3. In combination with an incandescent electric lamp having a carbon incandescing filament, a safety device in the main circuit, having the springs, E E', provided with adjusting set-screws, F F', for securing said springs at the requisite tension, substantially as described.

4. In a safety device for electric lamps, base, A, posts, B, arms, C and C', set screws, D and F, rod, H, contact-piece, I, arm, J, and binding-posts, K and K', the whole combined and arranged to operate substantially as shown and described.

Soirée at Guy's Hospital.—On the evening of the 2nd instant the annual soirée was held, and the rooms used for the reception were illuminated by Messrs. Siemens Brothers with the electric light. Fourteen Siemens differential arc lamps were employed in the wards, staircases, passages and courtyard; while 71 Swan lamps were placed in the Anatomical Museum, and 10 more in the Electrifying room. The current was derived from a W_1 alternate current machine which, with its D_7 exciter, was mounted on a tumbril carriage and driven by a Marshall portable engine. The W_1 machine was arranged for three circuits, two being used for the arc lamps and the other for the Swan lamps. The guests at the soirée numbered about 2,000, and much admiration was expressed at the effect of the illumination.

Electric Lighting at Birmingham.—At the Birmingham Town Council held on Tuesday last, the Mayor read a communication from Messrs. R. W. Winfield and Co., offering to present to the Town Hall the fittings and lamps, valued at £2,000, which were used during the recent Musical Festival for lighting the Town Hall by the Crompton-Winfield electric light, on condition that the authorities purchased the cables connecting the fittings with Messrs. Winfield's works in Cambridge Street, at their cost price, £800. Messrs. Winfield also offered to undertake the supply of electricity to the Hall. The Mayor stated that the average cost of lighting the Hall by gas was a little under £3 per night, whereas the estimated cost by the Crompton-Winfield light was £12 10s. per night. The matter was referred to the Estates Committee.—*Times.*

Electric Lighting in Manchester.—On Tuesday evening, the 26th ult., the works of Mr. A. W. Richardson, engineer, Manchester, were illuminated by four electric lamps, the invention of Mr. Charles Lever, of Bowdon. We understand that the lamps worked admirably, and we hear from Mr. Lever that he contemplates exhibiting the same at the forthcoming Crystal Palace Exhibition. The lamps, of about 2,000 candle-power each, were worked by

Marshall's four-horse vertical engine, the current being supplied by a Bürgin dynamo-electric machine. We are informed that Mr. Richardson, who has undertaken the construction of these lamps, has already been intrusted with a good order.

THE ELECTRIC LIGHT AT MESSRS. BOWYER AND PRIESTLEY'S FLOUR MILLS, BUCKDEN, NEAR HUNTINGDON.—A permanent installation of the electric light by means of incandescence lamps has recently been completed at the above mills. The electric current is generated by a Siemens continuous current dynamo-electric machine capable of maintaining 60 incandescence lamps, a number of which are distributed in all parts of the mill, passages, engines and boiler house.

As the mill runs all night, the steady, brilliant, and colourless light is found very advantageous, enabling the attendants to the various machines to examine the quality of the flour the same as by daylight.

The contract was intrusted to Messrs. Charles Powis & Co., and we understand the light is giving great satisfaction.

TENDERS WANTED.—The trustees of the Clyde Navigation have instructed their managers to obtain tenders for lighting the graving docks, Glasgow, and general terminus quay with the electric light; also for providing telephonic communication to different parts of the harbour.

THE EDINBURGH FAILURE AGAIN.—Mr. F. T. Mappin, M.P., in addressing the shareholders of the Sheffield Gas Company the other day referred to the failure of the electric lighting systems at Edinburgh, and said he believed that until the price of the electric light came somewhat near that of gas the consumption of the former would not be very large. Mr. Mappin will probably soon have good reasons for modifying his ideas on this subject.

LAYING A CABLE IN THE NARROWS.—A Correspondent has sent us the following cutting from an American newspaper: "The Baltimore and Ohio Telegraph Company has laid a cable across the Narrows from Fort Wadsworth to Fort Hamilton. A crossing so far down the bay was elected to avoid the danger of breakage or interrupted communication by ships dragging their anchors in stormy weather. The water at this point is very deep, and it is rarely or ever used by vessels as an anchorage. The tug-boat *Reba*, having in tow a scow that carried the cable, started from the pier at Fort Hamilton, and steamed across the bay. Among the passengers were R. Stewart, Superintendent of the Baltimore and Ohio Telegraph Company; C. W. Price, the New York manager; J. C. Haskinson, one of the road surveyors; Thomas T. Church, an old telegraph operator; and C. B. Hotchkiss. In the centre of the scow, coiled up on a large reel, was the cable, 6,500 ft. in length, and weighing 36,000 lbs. It contained seven copper conductors. Each wire has been given a coating of tin and covered with some insulating material. The seven wires have been bound together and encased in an armour of galvanised iron of the standard English No. 3 and American No. 2.

"The cable was manufactured by the Kerite Company, at its works in Seymour, Conn. It is 2¼ inches in diameter, and is the largest cable ever manufactured in this country. In comparison with English cables the insulation is heavier. Before landing the shore end the cable was tested by Mr. Price, for the Telegraph Company, and pronounced in good order. At 10.30 the shore end on the Staten Island side was made secure, and the word was given to start. For the first 1,000 ft. the wire was run out slowly, but as it became apparent that everything was in good working order the speed was increased, and in twenty-five minutes the crossing was made. Men stood by with water to prevent fire by friction, but their services were scarcely required, and the laying of the cable was pronounced a complete success. Some delay was occasioned in making fast the Long Island shore-end, because of the lowness of the tide, but by 1 o'clock everything was finished and communication between the two shores was established.

"The cable was laid under the direction of John Clark, who is a veteran in the service, most of the cables in this country having been laid under his instructions. Two smaller cables are to be laid, one between Tottenville and Perth Amboy, and the other between Perth Amboy and South Amboy. The line will then be complete to within a few miles of Philadelphia, and by October 15th the line is expected to be in operation."

TELEGRAMS FOR CAIRO.—The Eastern Telegraph Company notify the restoration of their direct wires to Cairo, and the re-opening of the business stations in that city. Telegrams written in code language are again accepted for all places in Egypt.

THE STEAM-SHIP "INTERNATIONAL."—The India-rubber, Gutta-percha, & Telegraph Works Company, notify the receipt of a telegram from Mr. Theophilus Smith, Engineer-in-charge, informing them that the s.s. *International* arrived at Gibraltar on Friday, the 29th, ult.

All well on board. After having filled up her bunkers with coal, she continued her voyage to Soussa, in Tunis.

CULTIVATION OF RUBBER-TREES.—We read in the Panama *Star and Herald*, that the cultivation of cotton and rubber is receiving great encouragement at the hands of the Executive in the Republic of Guatemala. It is felt that the generalisation of various crops is preferable to paying attention to the cultivation of coffee alone, and measures are being adopted which it is expected will produce good returns. One of these has been the issue of a decree on the 10th inst., from which great results are expected. A premium of seventy-five dollars, payable in gold, is offered for every thousand rubber-trees which are planted. This premium will be paid directly the trees reach five years of age. In order to prevent the decree being taken advantage of, the government stipulates that the land planted shall not be above 1,000 ft. above the level of the sea; whilst so as to encourage planters, the State will furnish gratuitously the young plants required for setting out. The cultivation of cotton is also encouraged, and a premium of two dollars will be paid by the Republic during the next five years on each quintal of cotton exported. These different dispositions have been warmly approved by the public, who fully understand that the growth of many products by agriculturists will prevent the embarrassment which has been caused this year by the comparative failure of the coffee crop. The cultivation of cotton has long been fully understood, and no difficulty will, therefore, be experienced in spreading the growth of this valuable staple. With the india-rubber tree, however, matters are different; and it is doubtful if any correct thesis has been published which would be of value to those who might desire to invest capital in what promises to be a most successful enterprise. Correspondence is therefore solicited on the subject, and if any of our readers can supply information, the columns of the *Star and Herald* are always open for the publication of anything referring to this important industry.

CABLE NEWS.—Many of the daily papers of Thursday, the 28th ult., as we noticed last week, contained a short statement, headed "Completion of a New Atlantic Cable," or something to that effect. These statements, however, were, we need scarcely say, invariably very inaccurate. The facts are that Messrs. M. H. Gray, J. K. Gray, H. M. Walter, J. Bailey, junr., and J. Mathieson, junr., of the Engineering staff of the Silvertown Telegraph Company, with 31 cable-hands, and 6 stewards from the s.s. *Silvertown*, returned from Panama per Royal Mail s.s. *Nile*, after the completion of the Central and South American Telegraph Companies' cables from Chorillos (Peru) to Salina Cruz, Tehuantepec (Mexico).

TELEGRAMS FOR EGYPT, &c.—Telegraphic communication with all parts of Egypt has now been restored. Telegraphic communication to India, China, the East Indian Islands, South Africa, and Australia, by the route of the Eastern Telegraph Company, is re-opened.

CABLE REPAIRED.—The cable between St. Thomas and St. Kitts is now repaired.

TIENTSIN AND CHEFOO.—A Shanghai telegram, dated August 29th, says telegraphic communication between Tientsin and Chefoo is about to be established.

TELEGRAMS FOR CHINA.—There is at present no telegraphic communication with Amoy, the cables between Shanghai and Amoy, and between Amoy and Hong Kong, being interrupted.

TELEGRAPH CABLE INTERRUPTED.—The cable between Fao and Bushire is interrupted.

ELECTRIC RAILWAYS.—Dr. Siemens is about to extend his electric railway system in Germany.

MANCHESTER MECHANICS' INSTITUTION.—The annual distribution of prizes gained by students of this institution was made on Monday by Mr. Oliver Heywood, in the presence of a distinguished audience. Mr. Martin, the teacher of the cla*s in telegraphy, gained at the recent City and Guilds of London Technological Examinations the second prize of £5, and a silver medal in the honours grade. Mr. D. F. Dallas, in the ordinary grade, carried off a prize of £3 and a bronze medal. A noteworthy feature of the distribution was the presentation of certificates to the Misses Smith, of the Lancashire and Cheshire Telephone Company's Exchange, who are the first young women in the kingdom who have gained certificates from the City and Guilds of London.

UTILISING ELECTRIC CIRCUITS FOR VARIOUS PURPOSES.—On Thu rsday week Prof. Barratt, of Dublin, exhibited to the directors of the National Telephone Company, at their offices in Edinburgh, his system of utilising electric circuits for various purposes. We gave a short description of Prof. Barratt's system on page 408 of last volume.

PERSONAL.—It is with regret we learn that Mr. Spottiswoode (President of the Royal Society) has met with an accident and broken his arm. We are, however, glad to hear that he is doing well and hopes soon to be again about at his work. A number of our readers are doubtless aware that Mr. Spottiswoode has recently fitted up a very extensive set of apparatus to assist him in his inquiries into the principles which govern electric action. Any serious check to his labours is, therefore, to be deplored.

THE ELECTRIC LAUNCH.—The following particulars concerning the *Electric Launch* supplementing the information already made public in the columns of the *Times*, are supplied to us by Professor Silvanus P. Thompson :—The launch is built of iron except the decks and cabin fittings. Her length is a trifle over 25 ft.; breadth of beam, 5 ft.; draught, 1 ft. 9 in. forward, and 2 ft. 6 in. aft. She can hold 54 accumulators of the type described in the *Times*. The Corliss-Browne propeller is 20 in. in diameter with 22 inches clearance and 3 feet pitch. The screw makes 350 revolutions per minute, while the machines run at 900. The weight of the two Siemens dynamos is 640 lbs.: the accumulators weigh 1¼ tons. The calculated average speed is 9 miles per hour, which was indeed attained on the trial trip; the speed being a little under 8 knots against the tide, and over 11 knots with the tide, though the belts slipped a little owing to their being new. The design and construction of the details of the boat are chiefly due to Mr. A. Reckenzaun, mechanical engineer to the Electrical Power Storage Company. After testing accumulators of the pattern used Prof. Thompson endorses the claim that they can furnish a current of 30 ampères for over 10 hours.

A GENTLE HINT.—The National Telephone Company gives public notice that during the winter months the progress of erecting telephone lines, owing to snow-storms, frost, &c., is much retarded, and suggests to those who are intending, during the course of the next six months, to become either subscribers to the Exchange, or renters of private wires, the desirability of giving in their orders now, to save delay and consequent disappointment.

NEW COMPANY REGISTERED.

ELECTRO-AMALGAMATOR COMPANY (LIMITED).—Capital £20,000, in £100 shares. Office: Tower Chambers, Finsbury Pavement. Objects: To purchase the letters patent No. 3,046, dated 28th June, 1882, granted to Richard Barker for the invention of a more profitable extraction of gold and silver by means of electricity. Signatories (with one share each): Henry Beckwith, 96, Palmerston Buildings; W. J. Tanner, 5, Argyll Road, Kensington; G. Rudall, 3, Waterloo, Kilburn; Henry Beckwith, Junr., Leyton; R. S. Gladstone, Tower Chambers, Finsbury Pavement; C. T. Gladstone, The Albany; W. R. May (electrician), Malvern Road, N. Registered 27th September, by R. S. Fraser, 23, Moorgate Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

THE following returns have been recently filed:—

INDIAN AND ORIENTAL ELECTRICAL STORAGE AND WORKS COMPANY (LIMITED).—The return of this company, made up to the 25th of July, was registered on the 25th ult. The nominal capital is £400,000, in £5 shares. 30,000 shares have been subscribed for and £2 per share called up. The call has been responded to to the extent of £59,018, leaving £982 unpaid.

LONDON AND PROVINCIAL ELECTRIC LIGHTING AND POWER GENERATING COMPANY (LIMITED).—The return made up to the 21st September was registered on the 28th ult. The nominal capital is £250,000, in £5 shares. 13,813 shares have been taken up and the full amount called thereupon. The calls paid amount to £66,839 and unpaid to £2,226.

PROVINCIAL (BRUSH) ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return made up to the 23rd of August was filed on the 6th ult. The nominal capital is £200,000, in £5 shares. The number of shares taken up is 19,841, and a call of £2 10s. has been made. The calls paid amount to £44,189 10s. and unpaid to £5,413.

DEVON AND CORNWALL ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to the 20th ult., was filed on the same date. The nominal capital is £100,000, in £5 shares. 9,276 have been subscribed for and £2 10s. called thereupon, and 1,850 shares have been issued as fully paid. The calls paid amount to £18,902 and unpaid to £4,288.

CALLENDER'S BITUMEN TELEGRAPH AND WATERPROOF COMPANY (LIMITED).—The return of this company, made up to the 2nd of June, was filed on the 6th of June. The nominal capital is £40,000, in £10 shares, the whole of which have been subscribed for and paid up.

NEW PATENTS—1882.

4625. "Improvements in Planté's secondary batteries, and in apparatus connected with such or other batteries." ST. G. LANE-FOX. Dated September 28.

4645. "Electric meters." S. D. MOTT. Dated September 29.

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4661. "Means or apparatus for registering the supply of electricity." J. H. GREENHILL. Dated September 30.

4665. "An improved electro-motor." M. IMMISCH. Dated September 30.

4674. "Steam-engines and the operation of electrical generators thereby." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated October 2.

4676. "Improvements in incandescent electric lamps, and in the preparation of the carbon filament therefor." J. F. PHILLIPS. (Communicated by C. H. F. Müller.) Dated October 3.

4680. "Dynamo-electric and magneto-electric machines." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated October 2.

4691. "Improvements in the generation and distribution of electric energy, and in apparatus therefor." F. C. PHILLIPS. Dated October 2.

4694. "Machinery and apparatus for generating and utilising electricity." E. EDWARDS, A. F. ST. GEORGE, and H. L. PHILLIPS. Dated October 3.

4695. "Electric lamps." E. EDWARDS and A. F. ST. GEORGE. Dated October 3.

4696. "Electrical accumulators or secondary batteries." A. F. ST. GEORGE. Dated October 3.

4712. "Electric bells and alarm clocks, and apparatus to be used in connection therewith." B. W. WEBB and H. P. F. and J. JENSON. Dated October 3.

The Chairman: The second resolution I have to propose is that the preference dividend, at the rate of 10 per cent. per annum, less income-tax, and a dividend of 3s. per share on the ordinary shares, free of income-tax, for the half-year ending the 30th June last be, and are, hereby declared.

Mr. Edmund Etlinger seconded the motion, which was likewise carried unanimously.

The Chairman: I do not know if the shareholders are aware that we are going to leave our present offices, and go into new ones, which will be very much nearer the centre of business, and altogether very superior offices to those which we now have, and no doubt when we have once got there it will contribute to the increase of our business. It will be far more handy for the greater number of our customers, and, altogether, it will be a decided advantage to the company, and will result in some increase of business. Our new offices will be at the corner of Leadenhall and Gracechurch Street, and we consider ourselves fortunate in getting such a good position.

Mr. W. Stimpson said that while this was a very successful piece of business, they must remember that the interests of the ordinary and of the preference shareholders, though identical in the matter of general success, were not quite identical in the division of the money. The ordinary shareholders had waited several years without getting any interest at all, and now when the takings were large, and the profits certainly proportionately so, they did think that by this time they should have got 5 per cent. There was wisdom, no doubt, in making a good reserve, but would it not be reasonable to hope that it should not be too largely increased when preference shareholders were getting 10 per cent out of the company. If the reserve increased to a very heavy amount, preferential shareholders would stand in a very fine position, but it would be somewhat at the expense of the interests of the ordinary shareholders.

The Chairman asked if the speaker could point out to the directors any way in which they could place the ordinary shareholders in a more satisfactory position? They could not help the advantages of the 10 per cent. preference shares. They had been glad to get them taken when they were, and any ordinary shareholder might take preference stock. It was as much the interest of the ordinary shareholder as of the preference that there should be a very large reserve. If they were to give them a larger dividend than they thought it at present prudent to do—then suppose the cable broke, and their reserve was so low that they could not repair it—the dividend would disappear altogether, and it would be very doubtful whether it would reappear again or not. The best practical proof of the importance of having a reserve fund was seen when their cable broke last. In consequence of having a reserve of upwards of £5,000, their shares only went down some 10s. or 15s. per share. But when, some years ago, the cable broke and there was only a small reserve fund, their shares went down to about £1 10s.; nobody, indeed, would have them. The fact of having a good reserve fund gave the ordinary shares a price in the market which they would not otherwise have borne, and people were content to pay that price and wait, with a moderate dividend, until the company was in a position to pay a higher dividend. Certainly the ordinary dividend at present was a very poor one upon the amount of paid up money upon the shares; yet a great many people held shares that were bought at £3, and, as far as they were concerned, 3s. per share was a very handsome return. Still he did not look upon that as a dividend likely to be normally paid. They expected, if they had anything like fair luck, to pay a very much larger dividend by-and-bye. But they could not alter the position of the ordinary and preferential shareholders. If they could get rid of the preference shares they should be very glad to do so, but no preference shareholder would give up his rights.

Mr. Stimpson said he had only risen to express the hope that the reserve would not be made too large at the expense of the ordinary shareholders; that they were not to be made the means by which the preferential shareholders should get their dividends as safe as consols while the ordinary shareholders were being a little bit starved.

The Chairman said that they were not the only company in which the same state of things as regarded share capital existed. The Cuba under similar circumstances had issued 10 per cent. preference shares, and it had been discussed in all manner of ways how to get rid of these shares since. The discussion, however, had never resulted in anything that was practicable.

Mr. M. Gray said that the neighbouring company to the Cuba had done otherwise.

The Chairman said that was because they were insolvent (laughter); they had come to the shareholders and said that there was no chance of getting preference dividends for many years to come; of course this company could do nothing of the kind.

Mr. Gray said that that was the case. There was no doubt that the preference shareholders had got a legal position, and a pretty strong one, and were never likely to give up their vantage ground. The having of a big reserve fund, no doubt, tended to give a greater market value to the preference shares, because it secured, in the eyes of investors, the payment of a dividend.

The Chairman said that that was inseparable from the constitution and issue of preference shares. They could not have got the capital raised but for these preference shares; they were glad to get it at the time, and they had no means of doing away with the conditions of issue. The ordinary shareholders got as much benefit from the reserve fund as the preference shareholders in the long run.

Mr. Stimpson said his only point was not to made the reserve fund too large.

The Chairman said that was a very fair question to raise, but they were a long way from considering that question yet. Looking at the cost of their cables and the amount of their reserve fund, they would find that they had a smaller reserve fund proportionally than any other company he knew of. If they wished this company to maintain a solid position they must continue to add to the fund every half year. When it did reach a considerably larger amount, then it might be [illegible] to consider whether they could not reduce the half yearly addition to the reserve fund, but not till then. There was no other business before the meeting, and he would only thank those present for their attendance.

The proceedings then terminated.

THE JABLOCHKOFF ELECTRIC LIGHT AND POWER COMPANY.

Under the presidency of Mr. James Wilson, an extraordinary general meeting of the shareholders of the above-named company took place, on Tuesday afternoon, at the City Terminus Hotel, Cannon Street. The secretary, Mr. F. H. Reeves, having read the notice convening the meeting,

The Chairman said it was simply his business now to move that the special resolution, which was passed on the 15th of last month, "be, and is, hereby confirmed;" and as he had fully explained the importance of the suggested alterations, which were dictated by the Committee of the Stock Exchange before they would grant the company a settlement, he did not think it necessary to go further into the matter now. He begged then to move "That the articles of association be, and the same are, hereby altered as follows:—1. By the omission of articles 16, 20, and 31. 2. By the omission of the following words 'and the dividends, if any, forfeited therewith' from article 32. 3. By the omission of the word 'meeting' between the words 'such' and 'to' in article 48, and the insertion of the words 'business shall be given' instead thereof."

The motion, having been seconded by Mr. Tooley, was put to the meeting and carried, and the proceedings terminated.

HENLEY'S ELECTRIC LIGHT AND POWER COMPANY.

The statutory meeting of the shareholders of the above-named company was held at 4, Coleman Street, on Monday, Mr. Morgan Lloyd, Q.C., M.P., presiding.

The Chairman said: Ladies and gentlemen, we ought, properly speaking, to call upon the secretary to read the notice convening the meeting; but, as there is no copy of it in the room, perhaps you will take it as read. This is, as you know, what is called the statutory meeting of the company, required to be held by Act of Parliament, within four months after registration. At that meeting, as a rule, very little is considered, in fact, no business can very well be done at the first statutory meeting, because companies are very seldom indeed in a position to show any work done besides the starting, in so short an interval from the date of registration; and therefore what is usual is for the shareholders to meet together to receive a short statement in connection with the company's affairs up to that date. Now, gentlemen, I am sorry that I have not a great deal to say to you, because, owing partly to what some people call the long vacation, and others the "dead season," and others, a holiday, when people are out of town, it is difficult to get engineers, and even business men, to attend to business throughout that period. This company having come into existence not very long before the "dead season" commenced, there has been very little done. The directors have taken care that the money subscribed by the shareholders should not be used until it could be so profitably, and it is now in the bank, not one penny of it having been spent. Of course it is satisfactory to know that the money is safe; but you may naturally ask, "Well; why has not something been done?" One reason for that is this, that certain arrangements have not yet been completed which will enable the company to commence work on a business footing; but negotiations are going on which I believe are likely to result in a satisfactory manner. So far as the purchase of the business and of the patents from Mr. Henley is concerned, Mr. Henley has agreed with the company that until things are in such a condition as will fairly enable us to see our way to make the company a success, he will not ask for one shilling on any paid-up shares from the company. That, so far, shows what faith Mr. Henley has in his own inventions and in the value of his patents. We have had communications from two or three sources, and we have been offered a concession of very considerable value from one of the first Governments of the world (I am not at liberty now to mention the name of the country), but it one of the first of the great powers. The concessions are of considerable value, and are for lighting up some public works. The moment we find ourselves in a position to do so we shall take up the concessions. There have been applications also to Mr. Henley for dynamo machines, which we have not yet felt ourselves in a position to accept, but which remain open. The directors have been assisted most materially by the solicitor of the company, and are now in negotiations upon various matters; and I hope when we meet again, and perhaps long before we meet again as a company, that I shall be in a position to lay before you a satisfactory statement with regard to all those matters under negotiation, but in the meantime I must ask you to trust your directors with the business. We are doing what we can to mature matters, and when they are so matured we shall take you entirely into our confidence. We have been asked to keep private certain names, and until the contracts are completed we have no right to make them public. I may tell you this, gentlemen, that for the present or until we are in a position to commence business, we have taken care that no expenses should be incurred; offices are supplied to us for nothing by our solicitor. The secretary for the present does his work gratuitously, believing that the company will be a success and the time will come when he will be paid. We have incurred no expense, and it is intended to incur none until we find we are in a position to commence business. That, I think, is all I have to tell you.

The proceedings concluded with a vote of thanks to the chairman, proposed by Mr. B. L. Baynham, seconded by Mr. Ball.

the figure, although this method may be reversed. But for the better understanding of the following description of the various plans under this invention, it will be taken as granted that the lower or negative holder is the one urged forward by the step-by-step movement; and that the re-adjustment of the arc is effected by the upper or positive holder. In the invention before cited it is proposed to accomplish the re-adjustment of the arc, after a certain number of impulses of the feeding magnet, by short-circuiting the main or arc-striking magnet; now it is found in practice it is much better to reverse its polarity. This is done, according to this invention, by winding the main magnet, M, differentially by a shunt coil, S, across the arc; but the said shunt coil, S, which reverses it, is only put momentarily in circuit at the readjusting periods. It is also proposed, in addition to this momentary reversal of the polarity of the main magnet, that another magnet wound in preferably the same shunt as the reversing coil be sometimes placed in opposition to the said main magnet, M, at x, though not shown in the drawing, in order to pull the armature, A, smartly away from the poles of the main magnet, as the residual magnetism or the over or under reversal of its polarity might prevent the armature retiring with that suddenness which is so essential to the proper performance of the lamp. A mechanical sudden contact arrangement, suitable for the said momentary periodical reversals of the main magnet, is substantially as follows, and is shown in fig. 1—viz., the magnet, F, which gives the step-by-step movement to the lower carbon-holder, also turns a ratchet wheel, W, substantially as described in previous patent referred to; but this wheel, W, is furnished with a projecting insulated boss, B, upon which a spring or lever, L, rests. An insulated pin, P, is placed near the outside of the said wheel, so that as the wheel revolves the pin, P, will lift the lever or spring, L, off the boss, B, and at a certain part of each revolution allow the spring to drop suddenly upon the boss, B, again; now a contact spring or pin, K, is placed on the said rotating wheel, W, occupying a position between the said insulated pin, P, and the boss, B, so that as the lever or spring falls from the insulated pin to the insulated boss it will rub or touch the said metal or contact spring or pin, K, momentarily. Now, this momentary contact completes the reversing coil, S (and opposing magnet, if any), as before described, and thus the arc will be re-adjusted to its correct length as the clutch, E, will allow the carbons to meet and then lift the top carbon the correct distance. It will be seen that according to the foregoing method the feed and regulation of the lamps do not depend upon the variations in the length of the arc or the particular requirement of any lamp in a circuit, but the regulation is purely mechanical and arbitrary, although, of course, the rate of feed and the intervals of re-adjustment are based upon the well-ascertained rate of consumption and character of the carbons employed.

905. "Secondary batteries." J. W. Swan. Dated February 24. 4d. Has for its object the more economical production of lead in a finely divided state with a view to its use in connection with the pole plates of secondary batteries and also the construction of pole plates not liable to oxidation. In carrying out the first part of the invention the inventor takes galena or sulphide of lead in a finely divided state and reduces it to the state of metallic lead by acting upon it by hydrogen evolved in process of electro chemical action or by hydrogen evolved by chemical action. In the first case the inventor places it in contact with the negative or hydrogen pole of an electrolytic cell containing hydrochloric acid or other suitable electrolyte, and through which an electric current is passed until the required reduction of the lead to a metallic state is effected. The inventor sometimes promotes the decomposition by stirring the sulphide, either by moving the negative pole amongst the mass of sulphide and acid or other electrolytic liquid, or by employment of a stirrer unconnected with the poles. It is also proposed to effect the reduction of the lead sulphide to a metallic state by the chemical action of metallic zinc or metallic iron in contact with the sulphide and acid, and to promote the action by stirring and the application of heat. Having produced the finely divided lead in the manner described, the inventor applies it to the pole plates of secondary voltaic cells of the type of cells known as Planté's secondary cells to facilitate the formation of oxide of lead on one of the pole plates and the occlusion of hydrogen on the other of the pole plates.

922. "Transmitting and receiving audible signals by electricity." A. F. St. George. Dated February 25. 8d. Relates to apparatus used for the purpose of acoustical electric telegraphy or telephony, and it has for its objects novel methods of construction and arrangement of such apparatus so that it is more simple and effective, and at the same time cheaper in manufacture and working than apparatus for such purposes as heretofore ordinarily constructed and used.

943. "Machinery for obtaining continuous or alternating currents of electricity." Henry Edward Newton. (A communication from abroad by Alphonse Isidore Gravier, of Paris, in the Republic of France.) We shall refer to this apparatus fully in our next issue.

958. "Cutting and reeling paper for telegraphic purposes, &c." W. W. Colley. Dated February 27. 6d. Relates to apparatus for cutting a roll or web of paper of the usual width into strips suitable for use in recording and printing telegraphic instruments and for other purposes, and simultaneously reeling such strips.

985. "Apparatus for lighting gas by electricity, &c." C. L. Clarke and J. Leigh. Dated March 1. 6d. This invention relates to improvements upon the apparatus for which previous Letters Patent No. 2229 in the year of our Lord one thousand eight hundred and eighty and No. 245 in the year of our Lord one thousand eight hundred and eighty-one have been granted to the inventors; the first part of the said invention consisting in improvements in the general construction and arrangement of an electric lamp for lighting gas, and the second part of the same consisting in an improved battery which besides being specially adapted to the improved electric gas lighter is also applicable to other electrical appliances wherein a small portable battery is required.

CITY NOTES, REPORTS, MEETINGS, &c.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

At a meeting of the board of directors, held on the 4th inst., the accounts for the six months to the 30th June last were submitted, and showed a balance of £12,621 5s. 11d. on Revenue Account. The directors decided, after placing £5,000 to reserve, to carry the balance of £7,621 5s. 11d. forward. In consequence of the unusually heavy cost of repairs to cables during the past and current half years, the directors are unable to recommend a payment on account of the arrears of dividend on the Preference Shares.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

On the 29th ult., the eighteenth ordinary general meeting of the above company was held in Cannon Street Hotel, Neil Bannatyne, Esq., chairman of the company, presiding. There was only a small attendance of shareholders. The Manager, Mr. C. Gerhardi, having read the notice convening the meeting, the Chairman said: I suppose you will take the report and accounts as read. ("Agreed.") The report and accounts having been in your hands, and you having no doubt given them a careful perusal, I think there is nothing in them that requires any special remark before I propose the first resolution. The shareholders, I think, will have looked at the accounts, as the directors have done, with perhaps somewhat mixed feelings. As regards the increased traffic, we look upon that with great satisfaction. It has been steadily maintained from month to month throughout the half-year, with the exception of the month of May, during the greater portion of which month the Bilbao cable was interrupted. While we look at the increased traffic with great satisfaction, that is somewhat modified by the circumstance that we did not get the result which we would have anticipated from our increase of traffic, in consequence of our having had to repair the Bilbao cable, which you will see from the accounts has cost us no less a sum than £2,814 9s. 4d.; and although that amount is not in excess of what we anticipated we should have to pay, although we do not consider it unreasonable, yet it was such as very materially to reduce the balance of profit which otherwise would have been at our credit, and which we could have disposed of. If we had had no interruption during that month, we would have been able to pay the ordinary shareholders a much higher dividend than we are declaring to-day. We would also be able to add more to the reserve fund than what we recommend you to do to-day, and we would have carried forward a larger balance than what remains, as you will see from the accounts. Still I must say, that for myself, and I suppose my colleagues agree with me, that I consider that we are in a more satisfactory position now than we have ever been. We have a reserve fund of £6,000; we have a steady increase of traffic over what we ever received before, and our prospects are altogether better, I think, than they have ever been when we met you on any previous occasion. I trust we will have no interruption in either of our cables for some time to come, and if we have not we shall no doubt be in a position to pay the ordinary shareholders a considerably higher rate of dividend than we do now, and at the same time add most materially in the six months to our reserve fund, which we all consider a matter of the highest importance to the welfare of the company. I may just say that for the three months of the present half year, which will expire to-morrow, our receipts will show an increase of something like £700. We can scarcely expect to maintain that increase for the rest of the half year, because our receipts for the corresponding three months of last year were exceedingly good, more than £2,000 a month. If we can only have the same traffic as last year—I trust we shall have an increase—but if we only maintain our ground as to receipts we shall be in a better position than we have ever been. Of course that is contingent on the cable working the whole time. I may mention for your information, that the fault in the Bilbao cable was in about 90 fathoms of water, near the French coast. The cable on both sides of the fault was found to be in exceedingly good condition—as sound as when it was laid. In looking at the expenditure, I may remark that although there is an unavoidable increase in consequence of increased traffic, the proportion of expenditure is not higher than it has been. As compared with the receipts it will contrast very favourably with that of other companies doing the same description of traffic. The board will continue to give its efforts to keep down expenditure as far as is consistent with the proper working of the lines. We are making arrangements to have a special wire between London and Falmouth. This will really involve little or no extra expenditure, as the cost will be less than the amount which we at present pay to the Post-office, and we are certain that we can derive great advantage from that arrangement. As regards the payment of the dividend, I may say that we have received a telegram from Madrid stating that the balance of messages accounts for the second quarter of the present year may be expected to be received, at all events the greater portion of it, by about the 15th or 20th of October, and whenever it is received the dividend warrants will be issued at once. I really do not think there is anything else that I have to mention. Of course, if any shareholder has any question to ask we shall be very happy to reply and give any information to the best of our power. I beg leave to move the first resolution to this effect: That the report and accounts now presented be, and the same hereby are, received and adopted.

Mr. Abraham Scott seconded the resolution, which was then put to the meeting and carried unanimously.

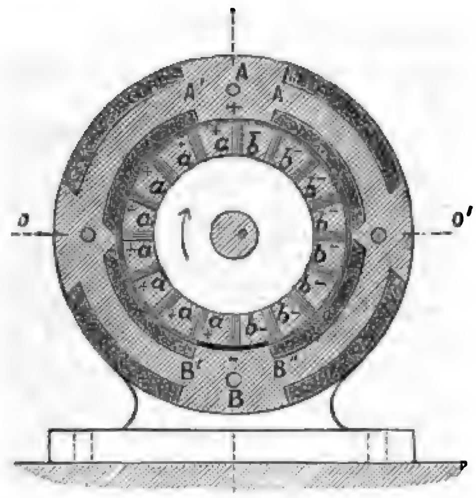


Fig. 1.

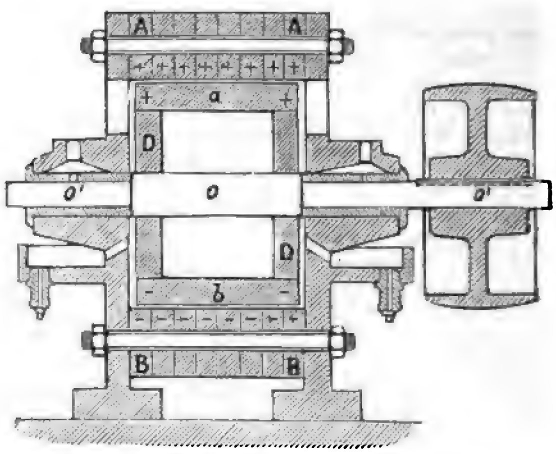
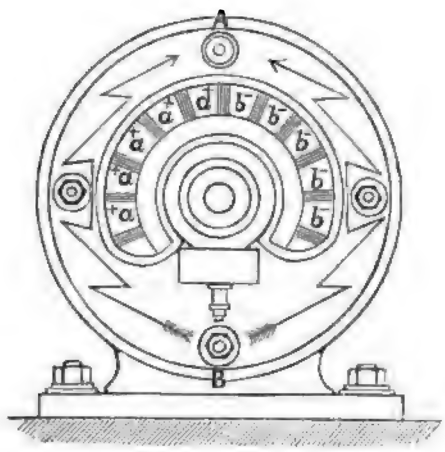


Fig. 2



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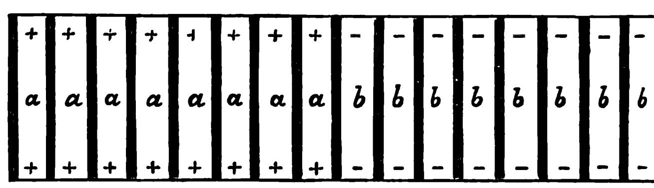
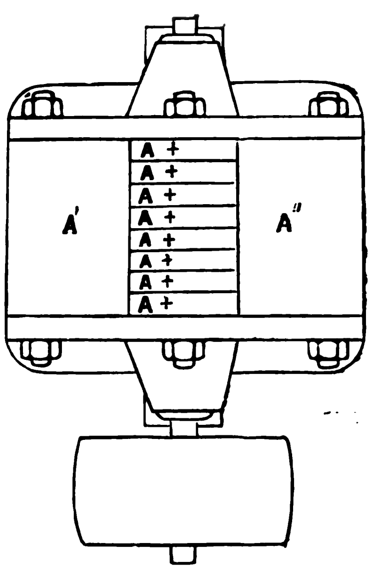


Fig. 4.



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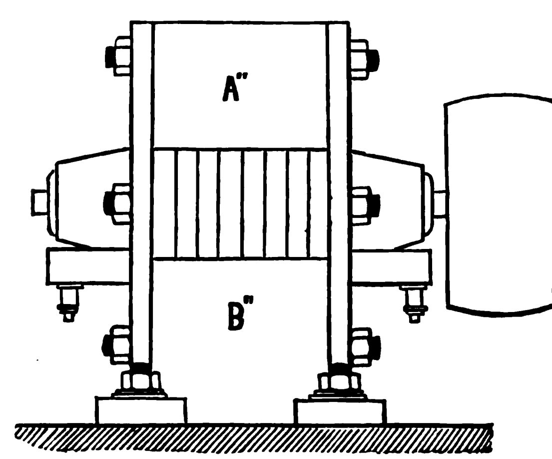

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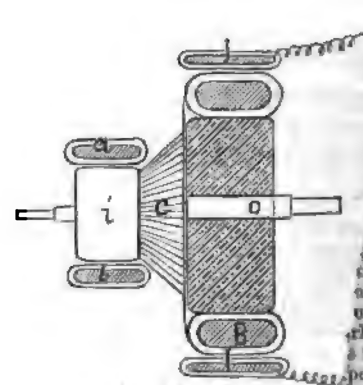

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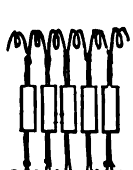


Fig. 9.

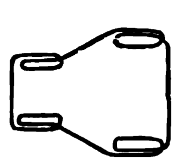


Fig. 10.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 255.

THE "FERRANTI" MACHINE.

Although so much interest has recently been excited in the public mind by the various reports which have been circulated as to the revolution to be effected in electric lighting by the new dynamo-electric machine devised by Mr. Ferranti, the effect on the shares of the other electric light companies has been comparatively nothing worth speaking of. Whether this state of things will continue remains to be seen ; but it appears evident that the public is beginning to understand what may be expected from the very best machines that we can ever hope to produce. We may mention here that the system of electric lighting of which we are now speaking, and which is being brought forward under the auspices of the "Hammond" Electric Light Company, is known under the name of "Ferranti" only, Sir William Thomson's connection with the former gentleman being in the alternating current machine of which they are joint inventors. An interesting correspondence, touching the efficiency of the new machine, has recently taken place in the columns of the *Times*, and a Mr. Pertwee—evidently an enthusiastic advocate of the Ferranti system—makes use of what knowledge he possesses regarding the merits of the recent invention to place the Brush machines in a bad light. The secretary of the Anglo-American Brush Electric Light Corporation has replied to Mr. Pertwee's criticisms, very much to the point ; however, we can only express a wish that the public will look at such correspondence with indifference, until they can be actually supplied with genuine figures on which to base their judgment.

It is easy for those conversant with the details of electric lighting to see where comparisons fail, but the general public cannot yet be expected to understand that machines constructed for arc lights will not answer for incandescence lamps. We stated in our columns a short time since that it was difficult to credit the stated low efficiency of the Brush machine for incandescent lighting, more especially if constructed for the latter purpose, and we now find that the results given were obtained from a machine manufactured for arc lighting. Eleven incandescent lamps, of 20 candle-power each per horse-power, from a Ferranti dynamo is not such an exceedingly startling performance as many would imagine, unless we understand by this that the horse-power is that of the engine, and not electrical. We do not know where Mr. Pertwee gets his information from concerning the large Ferranti machine for 25,000 lamps, and upon which he bases some comparative estimates, but we presume that all the various types of these machines are calculated from the experimental one. There is, however, really in existence a dynamo-electric machine, devised by another inventor, which we believe was constructed either for 5,000 or 8,000 lamps. This we hear is, experimentally, highly successful, and as many as 2,000 incandescence lights have at present been connected up with the machine. We are not at liberty to publish further information we have regarding this dynamo, the largest by far yet actually constructed, but as its results will be eagerly looked for we shall endeavour to keep our readers informed as to its performances. To the best of our knowledge, only a small experimental Ferranti machine has yet been tested, and on the strength of this the Hammond Electric Light Company has issued a pamphlet giving estimates for complete installations of the Ferranti system, from 25 to 25,000 incandescence lamps, and from 1 to 65 arc lamps, each system of lighting being from one machine.

We recommend this circular to the notice of all interested in electric lighting, and it may not be out of place to give some particulars here as to the estimated prices of these new machines. One F^2 Ferranti dynamo, for 65 lamps of 4,500 (nominal) candle-power each, £650, and an E^2 machine, for 32 similar lamps, £350. For 65 arc lamps, of 2,000 (nominal) candle-power each, one E^1 machine costs £350, and a machine for 26 similar lamps, £200. Concerning these latter it is stated that three-quarter indicated horse-power is required for each light. It would be premature to express an opinion on this matter at present, but one thing is certain, that if machines to produce the above results can be sold at the prices quoted, then the venture of the Hammond Electric Light Company will be well repaid ; and the public also will not be slow to take advantage of the greater inducements offered to further the progress of electric lighting.

NEW DYNAMO-ELECTRIC MACHINES

There is no doubt but that the commutator of a continuous current dynamo-electric machine gives generally more trouble, and requires more attention, than any of the other parts of such apparatus. The reasons why the commutator requires special care are too well known to electricians to render it necessary for us to dwell upon them ; and to do away with this portion of the machine altogether has long been the aim of many inventors.

We do not know of any successful result in this direction as yet, and when an invention professing to accomplish this object is brought forward it deserves more than passing notice.

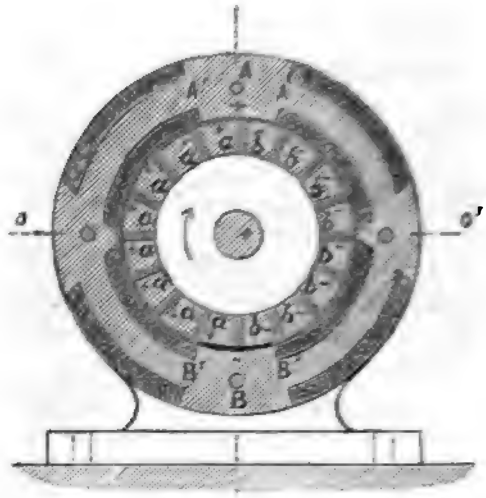
There has just been issued the specification of H. E. Newton (communicated by Alphonse Isidore Gravier, of Paris). M. Gravier's previous ideas are well known to electric light engineers, and the object of the present invention is the production of continuous or of alternating currents from a dynamo-electric machine, either in intensity, quantity, or in series, without the use of rubbers, collectors, brushes, or commutators.

The inventor says that by studying the action of dynamo or magneto-electric machines, one general fact which dominates them all is apparent, viz., the necessity for the commutation of the current produced.

Thus if a permanent or electro-magnet be caused to turn in front of a system of bobbins however arranged, currents are induced in these bobbins which change in direction at each half revolution of the inducing magnet.

This is all very well when such alternating currents can be utilised ; but should continuous currents be required, recourse must be had to various contrivances, such as commutators, rubbers, brushes, &c.

Besides this, the currents thus obtained and re-arranged are not continuous in the strict interpretation of the word. They are in the same direction, it is true, but they really consist of a series of short currents starting from zero, rising



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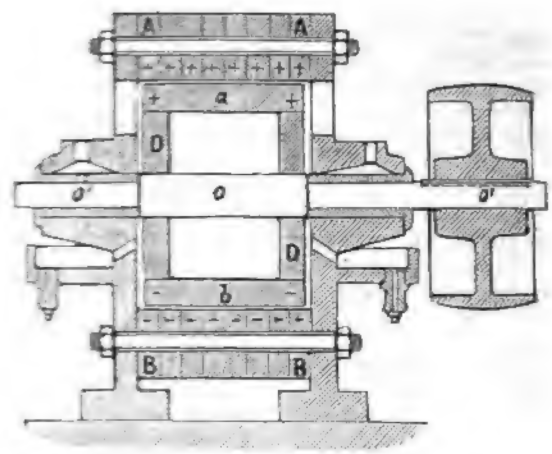

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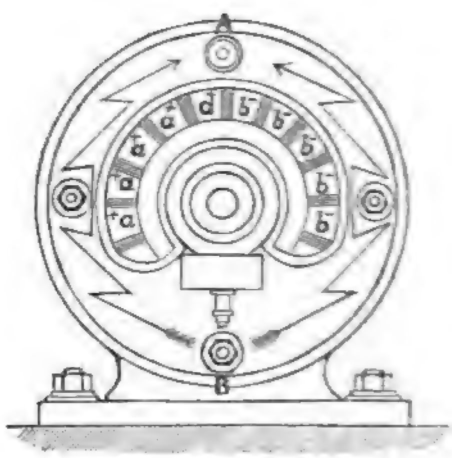

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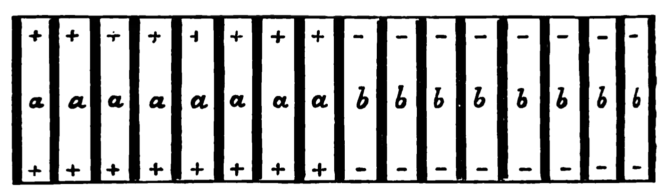

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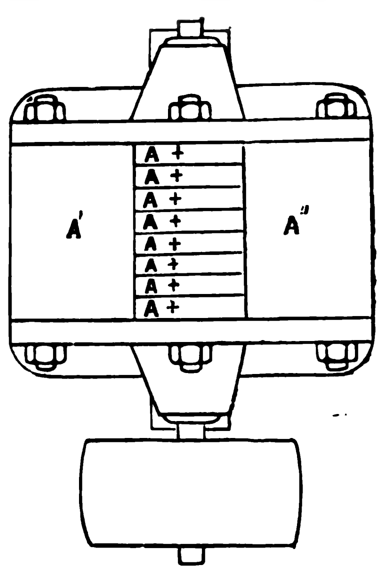

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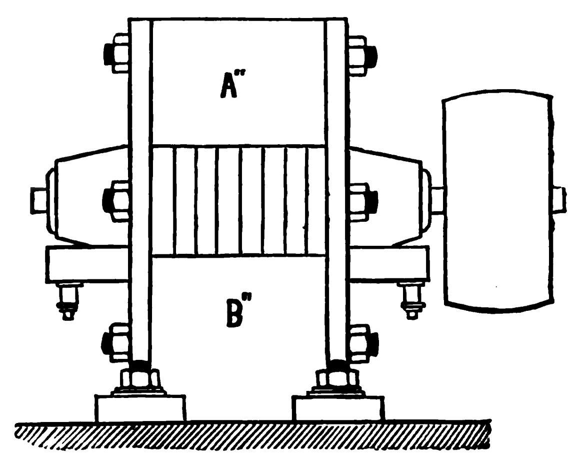

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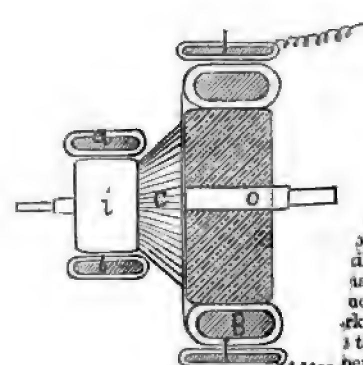
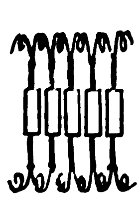


Fig. 7.



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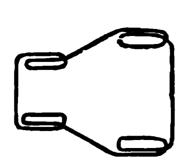

Fig. 10.

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to a maximum of intensity and descending again to zero, these currents being adjusted to each other by means of the commutators, rubbers, or brushes.

M. Gravier then illustrates diagrammatically the rise and fall of an ordinary alternating current, and also of a continuous current during one entire revolution of the inducing magnet.

He then, by means of other diagrams and experiments, shows that the successive inversions of the induced currents are due to the successive passages of inductors of opposite polarities. His conclusion is, that as the successive passages of opposite inductive polarities furnish induced alternating currents, it is only logical to suppose that successive passages of inductive polarities of the same sign, would furnish induced currents in the same direction and the rearrangement or commutation of the induced current would thereby be avoided; it would, however, be necessary to effect the commutation of the magnetic poles of the inducing magnets.

Therefore the chief object of M. Gravier's invention is to substitute for the commutation of the induced currents the preliminary commutation of the magnetic poles of the inducing magnets.

The inventor thus describes his apparatus :—

The magnetic commutation inductor will be composed of soft iron, copper or soft iron combined with copper, or any other metal which may offer advantages in respect to price or inductive capabilities.

As to its form it may take all those furnished by the solids of revolution or any other figure that can be inscribed in a solid of revolution; in a word, it may take any of the forms that an electro-magnet simple or compound is capable of taking, and it may be in a single piece or in a number of pieces.

It is to be placed in a magnetic field of one or of several permanent, or electro-magnets of which it sustains the magnetic influence. It is to be surrounded concentrically with circuits upon which it should exercise its inductive influence.

In certain cases it may be placed in the circuit of an exterior source.

Its movement determines the magnetic or electro-magnetic commutation of its elements.

Its motion will be by preference rotary, but in certain cases it may have an alternating rectilinear motion, or an alternating circular motion imparted to it.

It is influenced either by the magnetic field in which it is placed, by the current from an exterior source, or by both combined.

It will react by its motion upon the induction circuits in which it is placed. The induction armatures and the fixed induced circuits may be dependent upon each other, or may be independent of each other.

In the case of simple magnetic commutation no mechanical connection will exist between the movable induction armature and the fixed induced circuit. The only connection in this case is simply magnetic.

Figs. 1, 2, 3, 4, 5, and 6, of the accompanying drawings, represent various views of a continuous current machine constructed according to this invention, without commutator or collectors, but with magnetic commutation inductor.

Fig. 1 is a transverse section of the machine, showing the arrangements adopted for the magnetic commutation inductor or rotary armature and the fixed magnet.

Fig. 2 is a longitudinal section, and fig. 3 a side elevation of the same.

Fig. 4 is a development of the rotary armature of the machine, showing the arrangement of the magnetic polarities when under the influence of the poles of the fixed electro-magnets.

Fig. 5 is a plan of the machine.

Fig. 6 is an end elevation of the same.

The induction cylinder or revolving armature is shown as composed of sixteen bars of soft iron, *a a a*, *b b b*, separated slightly from one another by pieces of paper, or other suitable material. These bars are mounted upon and secured at their extremities to two discs of soft iron, D D, by means of screws, and the whole is mounted upon an axle, *o*, turning in suitable bearings.

The stationary field magnet, A A^1 A^{11}, B B^1 B^{11}, is composed of eight cast-iron rings, one of these rings being hardened so as to retain a certain amount of residual magnetism for the initial effect.

Fig. 1 shows the configuration and the mode of coiling of the field magnets.

The eight rings are separated by insulating material, and are clamped together by means of bolts, two exterior frames of cast iron provided with plummer blocks completing the iron part of the fixed field magnet, and being solidly clamped to the eight rings by the same bolts.

The winding of the wire is in actual practice divided in such a manner as to form forty separate circuits, the extremities of each of which terminate in a grouping table to allow of the circuits being grouped together in any way that may be found desirable either in quantity, tension, or in series.

On starting the rotary armature it will be polarised by the residual magnetism of the exterior magnet and an electrical current will be induced in the coils of the exterior magnet. This current will strengthen the fixed magnet which in its turn will strengthen the rotating armature and induce a current in the coils thereof.

A reciprocal action being thus set up the currents of electricity will flow from the terminals of the coils of the external magnet, which may be used as above stated without employing a commutator and collectors.

As a modification of the above, two rotary armatures of different dimensions may be mounted on the same axle, the larger one being coiled so as to produce two consequent poles, and the coils connected by metal plates with the coils of the adjacent smaller armature. Both armatures will be provided with field magnets, the larger field magnet being coiled so as to produce two or more currents, one or more of which should circulate in the coils of the smaller field magnet.

This arrangement is illustrated at figs. 7, 8, 9 and 10, of the drawings, fig. 7 being a vertical section through the axis of the machine, in which *a b* is an annular electro-magnet with two consequent poles within which is mounted upon an axle, *o*, the inducing ring, *i*. A B is another annular electro-magnet also with two consequent poles, and mounted upon a wooden filling piece keyed fast to the axle, *o*. The core of this electro-magnet, like all the others, consists either of cast iron or of thin plates of sheet iron, placed together and formed with notches, as seen in fig. 8. It is of sufficient size to admit of there being placed upon it about thirty kilogrammes of wire having a resistance equal to ten ohms, and is five times larger than the core of the ring, *i*.

c is a radial conductor which may be cylindrical or conical. To each of the plates of the conductor are connected on one side the entering and exit ends of two consecutive helices of the inducing ring, *i*, and at the opposite side the entering and exit ends of two consecutive helices of the inductor ring, A B, as indicated in the diagram, fig. 9, which also shows the course of the currents from the primary or induced to the secondary or inductor magnets.

Fig. 10 is a diagram showing another arrangement in which each helix of the ring, *i*, is connected to the corresponding helix of the ring, A B, in such a way that each pair of helices of the ring, *i*, forms with the corresponding pair of helices on the ring, A B, a closed circuit. The helices are in this case "in quantity."

Under these conditions in either of the two systems the induced currents of the ring, *i*, pass to the inductor ring, A B, just at the points, where in the ordinary way the brushes or rubbers would be placed.

In fig. 7, I I is a fixed exterior ring covered with, say, 7,500 kilogrammes of wire, having a resistance of 0·35 ohms.

On rotating the axes, *o*, carrying the two armatures, a continuous current will be induced in the wire of the ring, I I, which current may be utilised in any desired manner, a portion however being furnished to the primary inductor, *a b*.

We have thought the invention of M. Gravier of sufficient interest to many of the readers of the Electrical Review to give it a prominent position in our columns, but we shall reserve any remarks on this dynamo-electric machine for a future occasion.

The Iberian Electric Light Company is, we understand, in course of voluntary liquidation.

VYLE'S DOUBLE CURRENT KEY.

Speed and ease of working on the Morse system is greatly influenced by the form of key employed. The design of even the simplest form of single current key is by no means a matter of unimportance, though judging from some of the wonderful and fearful patterns of this simple piece of apparatus which we find illustrated in many of our electrical text books, it might be imagined that the matter is not of the slightest moment. Practical telegraphists, however, who are the best judges of such matters, know very well the advantages and disadvantages of particular patterns. The double current system, which in this country is largely employed, especially on long circuits, is worked, as is well known, by a key, which, by its action causes reversals in the line current; this arrangement necessitates the use of four contact points, and as it is necessary that two of these be brought into action when the key is depressed and the other two when it is raised, and moreover that the makes and breaks of contact be made with certainty, the *play* of the key has to be made comparatively large. This length of *play* is an objectionable feature in the double current key, as it hinders quick working, and moreover renders the latter more fatiguing than is the case with the single current key, where the play can be reduced almost to nothing. The object of Mr. Vyle's double current key is to reduce the amount of play down to that required for a single current key, without sacrificing the certainty of the contacts being properly made and broken. The general view of the key is shown by fig. 1.

Fig. 1.

It will be seen that eight terminals are provided, three of these are, however, simply for the purpose of enabling the key to be used for single current working, so that a single current and a double current circuit can both be worked at the same time; this feature is not, however, claimed as a special improvement.

The smallness of the play in the contacts is obtained by the following arrangement (shown by fig. 2*). The end, T, of the main lever ot the key is provided with a small roller, *r*, this roller presses against the short lever, *t*, fixed to the axle, *a*, on which are fixed two insulated springs, one of which, *s*, is seen in fig. 2. These insulated springs are connected to "line" and "earth" respectively, and play between insulated contacts as in the ordinary double current key. Now the lever, *t*, being short, a very small movement of the lever, T, will move the ends of the contact springs, *s*, *s*, through a considerable distance, so that the contact screws need not be set very close together, and as the motion is caused through the medium of the roller, *r*, the motion is very easy.

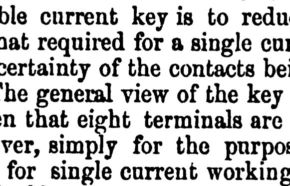


Fig. 2.

ure is drawn from the reverse side of the key to that shown

A special feature in the key is the vertical arrangement of the contact springs and their contacts, which renders the adjustment of the latter very easy, since they are easily seen and got at.

REVIEWS.

Guide des Epreuves Electriques. Par Valdemar Hoskiær. Traduit sur la seconde édition anglaise, par A. L. Ternant. Paris: G. Masson.

The translation of Capt. Hoskiær's well-known work could hardly have been undertaken by anyone better qualified than M. Ternant. The book being a mere translation does not afford scope for criticism, and we need not say more than that French scientific literature will be decidedly benefited by the addition of the work in question.

La Navigation Electrique. Par Georges Dary. Paris: Librairie Polytechnique de J. Baudry.

We have already alluded to this work in our last issue. Although it consists of but 65 pages the information given is very complete, and it is fully illustrated. The progress made in electrical navigation had been so small up to the time when M. Trouvé took the subject in hand, that practically the description of the system of this gentleman forms the bulk of the book. The recent successful experiments on the Thames have increased the interest in electrical navigation, and therefore the publication of M. Dary's work is very opportune.

Détermination des Eléments de Construction des Electro-aimants. Par M. Th. Du Moncel. Deuxième édition. Paris: Gauthier-Villars.

Much of the matter contained in this small work has already been published—indeed, in the early pages of the Electrical Review several articles on the subject will be found. Not only has M. Du Moncel very fully determined the theoretical laws which govern the construction of electro-magnets, but he has also verified the correctness of the results by experimental examples; this is decidedly a very important feature, as, although those *savants* who are able to follow the mathematical deductions would probably be satisfied with the conclusions arrived at, there are many who would hesitate to accept the statements unless they were verified by practical results. Interesting as the book is to lovers of theory—and there are many such—its value to

practical electricians is perhaps not great; continual experiment has effected what theory might have assisted if it had been developed earlier. It is very often the case that practice goes in advance of theory, and the latter, instead of effecting, merely explains results. This is very much the case with electro-magnets, for the best forms of the latter have been so nearly determined by experience that theory can now do but little to assist. Of course there may be further developments in the use of electro-magnets, especially as regards fast speed telegraphing, which have yet to be made, and which may be helped forward by a complete theoretical knowledge of the laws which govern the working of electro-magnets, and therefore the information which the Comte Du Moncel has carefully and ably worked out may yet prove valuable.

THE BREGUET REGULATOR.

The regulator of which we are about to give the description was devised by the *Maison Breguet*, with the object of making a simple and strong lamp little subject to derangement or accident, requiring no supervision, of easy installation, and moderate price. The principle of its construction is such that it can be established at will in derivation or in series upon a continuous current machine of sufficient power.

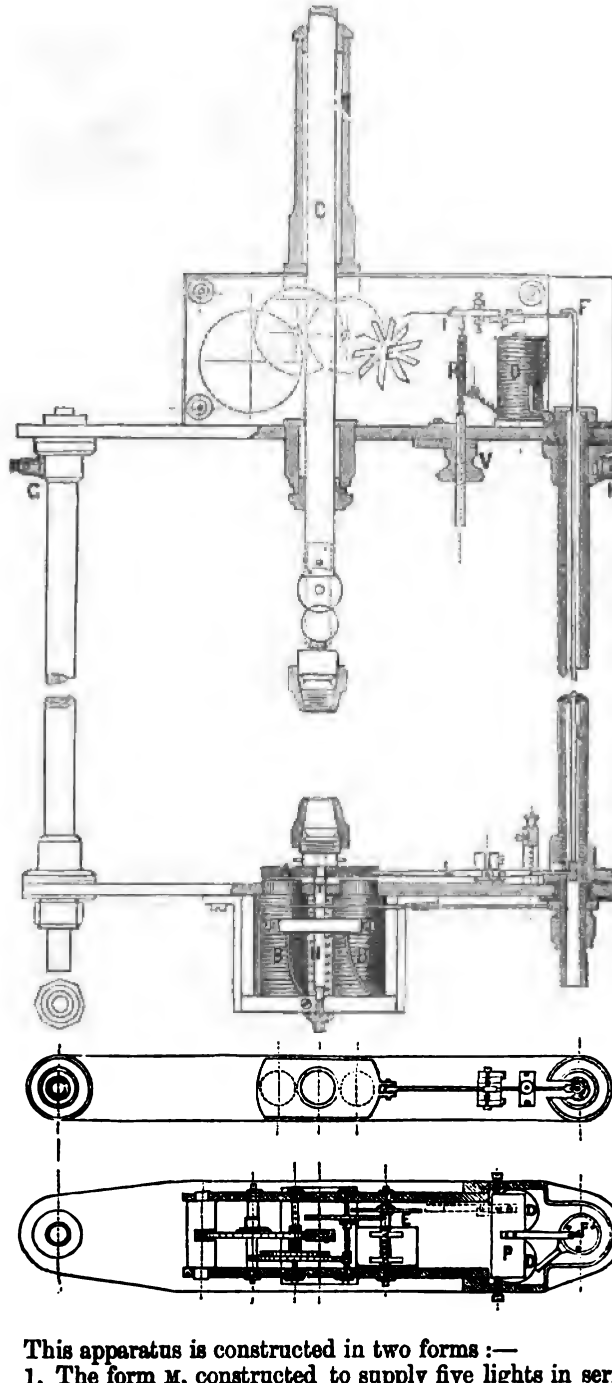
It may be defined as a weight and clockwork regulator, controlled by an electro-magnet in derivation and in which the initial motion is produced by the action of a second electro-magnet in circuit. The drawing will explain its arrangements and operation. The clockwork movement and escapement are disposed in a box placed at the upper part and traversed by a bar, C, which serves as the motive weight and carries the positive carbon. This bar commands a series of moving parts, of which the last is a star-shaped wheel, E, similar to the Serrin regulator.

This wheel is engaged by a flat spring fixed upon the armature, P, of the electro-magnet, D, joined up as a shunt, so that the current which traverses this coil is too feeble to counterbalance the opposing spring, R, the tension of which is regulated by the aid of the screw, V.

The negative carbon-holder is fixed upon a vertical rod, T, bearing an armature, A, placed in front of an electro-magnet of thick wire, B, in the main circuit, and moved constantly upwards by the action of a spiral spring, N, placed between the two branches of the electro-magnet. Let us suppose that, the apparatus being at rest, the carbons are in contact. The moment the current passes, coming from the terminal, G, it is split between the carbons and the electro-magnet, B, on one hand, and the shunt coil, D, on the other. The armature, A, is powerfully attracted, and produces the initial movement, whilst D, which at the beginning is not traversed by a sufficiently powerful current, keeps the wheel, E, locked. (We neglect for a time a part of the mechanism, of which we shall presently examine the function.) In proportion as the carbons are consumed, the arc is lengthened. The portion of the current which traverses D increases; at a given moment it becomes sufficiently powerful to disengage the star-wheel, E, which then allows the descent of the upper carbon, until the derivation, becoming again enfeebled, the spring, R, replaces the lever, I, and produces the locking of the star-wheel, E.

The regulation and the initial motion of the carbons is produced, therefore, individually in each lamp in a manner entirely independent of that of other lights, placed either in series or in derivation. It remains now for us to explain the *rôle* of the lever, L, of the rod, U, and the hook, F. If the carbons were always in contact at the time of lighting, these pieces would be useless, and we could easily dispense with them, but it happens sometimes that the carbons are very widely separated one from the other, when new carbons have just been inserted, for example, or when one of the carbons is broken, &c.

The combination of the lever, L, the rod, U, and the hook, F, is disposed in such a manner that, whilst the star-wheel, E, is always unlocked, and permits the descent of the upper carbon until it meets the lower, so long as the current does not traverse them; the moment they touch the armature, A, is attracted, the lever, L, oscillates around O, raises U, and the hook, F, which liberates the armature, P, and the lever, I. This arrangement could be dispensed with in machines separately excited or excited in derivation, because in these machines the current which would traverse the electro-magnet, D, at the moment of lighting would be sufficient to attract P, and unlock the star-wheel, E; but with machines in which the inductors are placed in the general circuit, the total resistance would be too great to produce the starting of the machine; the electro-magnet, D, would not act, and the regulators would prove defective. Owing to the ingenious combination which we have just described, such a drawback is avoided.



This apparatus is constructed in two forms:—

1. The form M, constructed to supply five lights in series by the aid of a Gramme machine, Type F, burning carbons of 12 millimetres, and using a current of 13 ampères, and 50 volts difference of potential at the terminals of the lamp. It furnishes a light of from 100 to 125 Carcel jets.

2. The form N, constructed to supply three lights in derivation upon a Gramme machine of the workshop type (Type A), burning carbons of seven millimetres, and working with a current from 5·5 to 6 ampères, and 50 volts difference of potential at the terminals of the lamp. The light given is from 40 to 60 Carcel jets.

The Breguet regulator can, therefore, be established either in circuit, like the Brush, Gramme, Lontin, &c., or in derivation, like the Gülcher lamp, according to the applications in

view and the current furnished by the machines we have at disposal. In the first case it is especially suitable for workshops of large size, railway stations, concert rooms, &c.; in the second, it is applicable to small low buildings in which the shadows cast necessitate lights of medium power and in greater numbers.

THE ELECTRICAL LAUNCH.

IT will be remembered that we briefly alluded in the last number of THE ELECTRICAL REVIEW to the trip we were privileged to enjoy in this electrically-propelled vessel. We are now enabled, through the kindness of Mr. Reckenzaun, C.E., the mechanical engineer to the Electrical Power Storage Company, to give our readers very complete detailed sketches of the *Electricity* and her machinery.

In an article to our esteemed contemporary *Nature*, Professor Silvanus Thompson gives an illustration and description of Jacobi's electro-magnetic motor which is sufficiently interesting to reproduce. Professor Thompson says :—

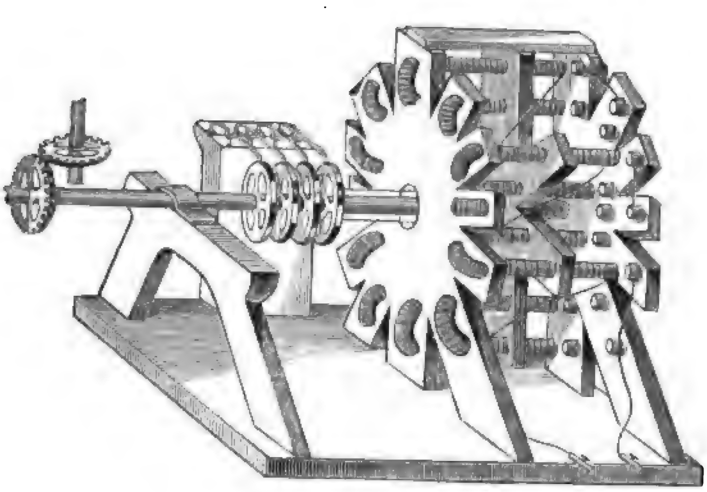


FIG. 1.

"Fig. 1, which we here reproduce from Hessler's "Lehrbuch der Technischen Physik," represents the rude electro-magnetic motor or engine which Jacobi devised for the driving of his boat. Two series of electro-magnets of horse-shoe form were fixed upon substantial wooden frames, and between them, centred upon a shaft which was connected to the paddle-wheels, rotated a third frame, carrying a set of straight electro-magnets. By means of a commutator made of notched copper wheels, which changed the direction of the current at appropriate intervals, the moving electro-magnets were first attracted towards the opposing poles, and then, as they neared them, were caused to be repelled past, so providing a means of keeping up a continuous rotation. This machine was worked at first by a Daniell's battery of 320 couples, containing plates of zinc and copper 36 square inches each, and excited by a charge of sulphuric acid and sulphate of copper. The speed attained with this battery did not reach so much as $1\frac{1}{4}$ miles per hour. But in the following year, 1839, the improvement was made of substituting 64 Grove's cells, in each of which the platinum plates were 36 square inches in area. The boat, which was about 28 ft. long, $7\frac{1}{2}$ broad, and not quite 3 ft. in depth, was propelled, with a convoy of fourteen persons, along the River Neva, at a speed of $2\frac{1}{4}$ (English) miles per hour."

Figs. 2, 3, and 4 show respectively a plan of the launch with the cabin removed and the longitudinal and midships sections. These illustrations are so self-explanatory that it only remains for us to refer to several minor details. A, A, are ampèremeters of the Ayrton and Perry construction, B is a commutator for putting in circuit extra secondary battery cells as may be requisite, and C, C, are switches by means of which the current supplied by the accumulators may be cut off from either or both machines. L is a clutch-lever for manipulating an "Addyman's" friction-clutch, by means of which one of the motors may be thrown in or out of gear without the slightest noise. H is a handle for applying the reversing gear, which is shown fully in fig. 5, where P and S represent the commutators of the two Siemens dynamo-electric machines, P M acting as port, and S M as starboard motors respectively. The two pairs of brushes are shown at a, a', b, b', and either pair can be made to touch the commutators by raising or lowering the spring-lever, R, the brush-holders, c and d, acting as cams, so that the same pressure should act upon all the brushes in action. By moving the handle, H, to the left, the opposite pairs of brushes of both machines will come in contact simultaneously, and the direction of the armature is instantly reversed. The screw-shaft is represented at O. It will be noticed that the power of the electro-motors is transmitted to the screw-shaft by means of belts and pulleys, since it was not desirable to work the propeller at from 900 to 1,000 revolutions per minute; and the screw, therefore, runs at 350 turns to give its maximum efficiency. The accumulators are placed partly under the seats and floor, and partly under the aft deck. The size of these cells is $7\frac{1}{4}$ in. high by $9\frac{1}{4}$ in. by $8\frac{1}{4}$ in., and the 45 constituting the battery weigh about 2,700 lbs. The commutator and switches before alluded to, the clutch-lever, reversing-lever, and steering-wheel, are all under the immediate command of one man. We understand that the launch has been running daily since the trial-trip, and the secondary cells of Messrs. Sellon and Volckmar have acted admirably, giving a constant current of 48 ampères for six consecutive hours. The maximum useful energy of these accumulators is four horse-power. They are charged through cables from a dynamo-electric machine in the works whilst the vessel lies at her moorings. A special propeller is now being constructed to be driven direct from the motor at a high speed, with a view of testing its efficiency.

A sketch of the entire electrical connections is shown in fig. 6. The accumulators are represented at A, leading to the commutator, B, by the employment of which the number of cells in circuit may be varied. C, C, show the switches for applying or cutting off the current to the machines (and to which the ampèremeters are connected), represented in outline, with their terminals placed below. The cells are all joined in series, and the two machines are coupled up parallel. The switches are so made that the ampèremeters may be inserted in the circuit at will, but in practice they are always on for convenience. We may add that the design and construction of the *Electricity* are due almost entirely to Mr. Reckenzaun, to whom we tender our thanks for the great assistance we have received at his hands.

We shall await with great interest further developments of electrical navigation by means of accumulators, and we congratulate the Electrical Power Storage Company, not merely on this application of electricity, but upon the success which will probably attend the energetic way in which they are going to work in the matter of electrical accumulators. The factory of this company is no mere experimental works, for the number of men now busily engaged in all the branches of secondary battery manufacture, exceeds 300, we believe. We hope shortly to place before our readers subjects of great interest connected with this work.

THE FRENCH POST-OFFICE.—The Minister of Posts and Telegraphs in France has published a report showing the results of the work transacted in his department last year, and the progress which has been made since 1877, at the end of which year the posts and telegraphs were detached from the Ministry of France and made into a separate department. There was an increase equivalent to 56 per cent. in the work of the Post-office, but the increase in the Telegraph Department was very much greater, amounting to no less than 138 per cent. The number of telegrams sent in 1877 was only 8,174,000, while last year it was 19,466,000. The number of post-offices open at the end of last year was 6,128, and in this respect France is not nearly so well off as most European countries, there being 30,120 parishes which have no post-office of their own. There are 52,032 letter-boxes, and 5,481 telegraph-offices, the total length of telegraph wires in France being 132,420 miles, in addition to 520 miles of underground telegraphs. The underground telegraphs are being laid with great rapidity, and a sum of two millions sterling has been voted by the Chamber to bring the total length of the underground line to 4,900 miles.

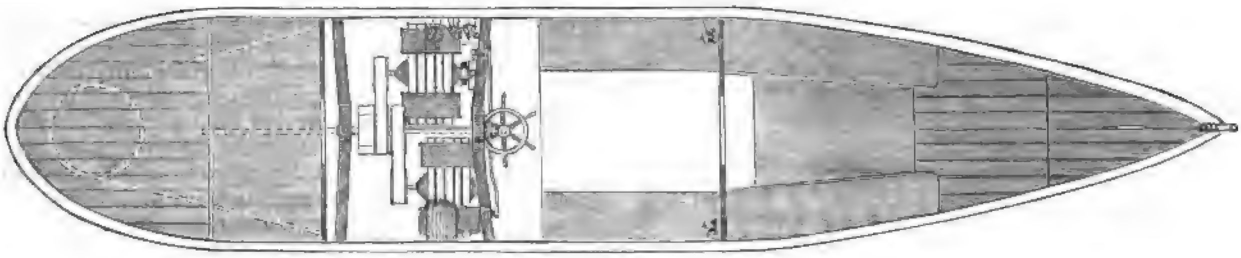


Fig. 2.

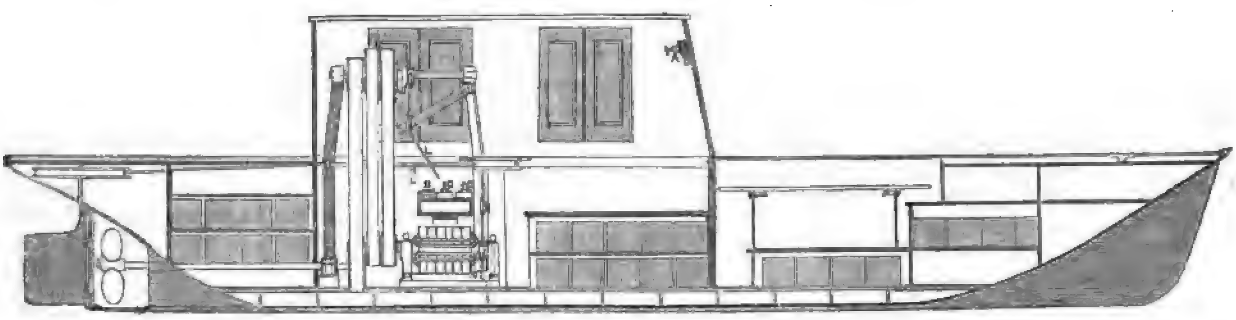


Fig. 3.

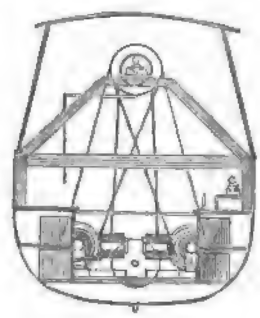


Fig. 4.

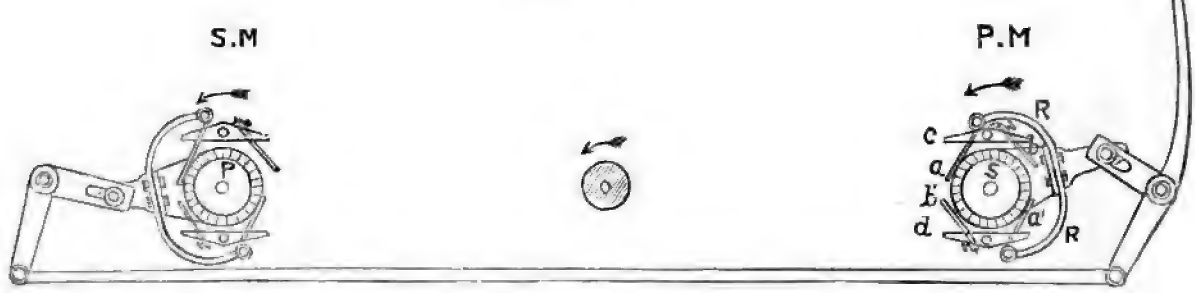


Fig. 5.

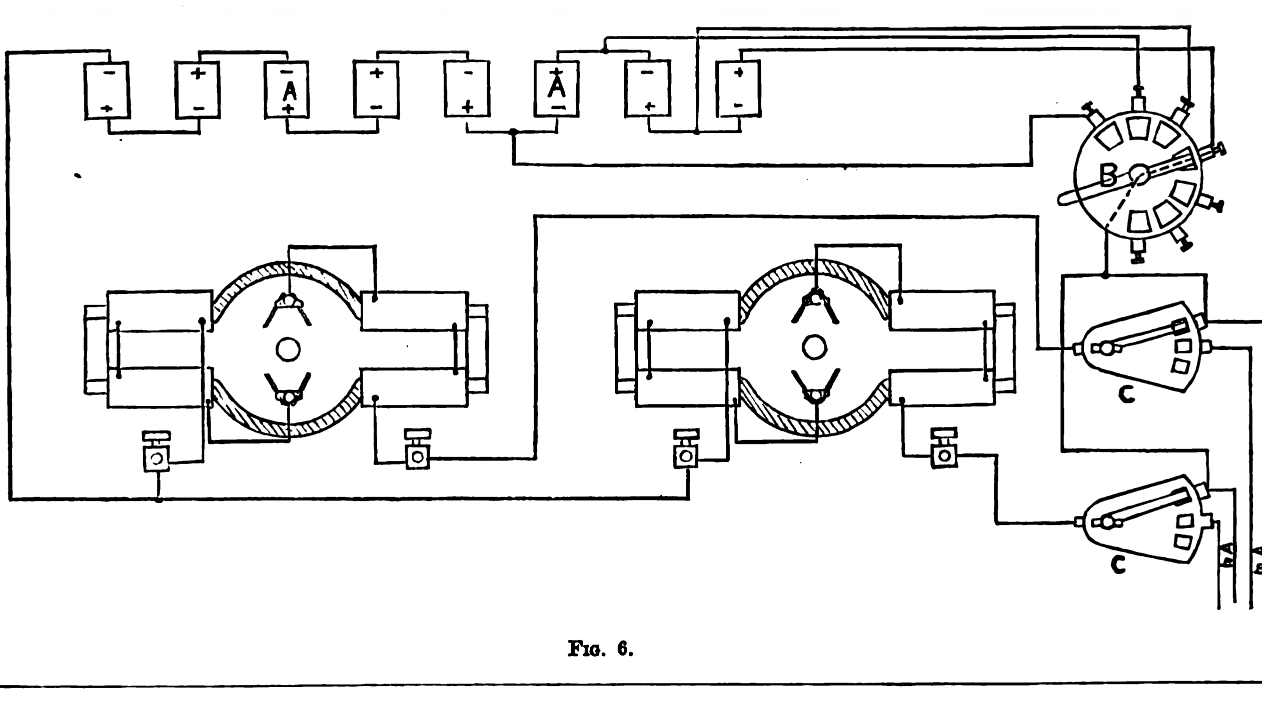


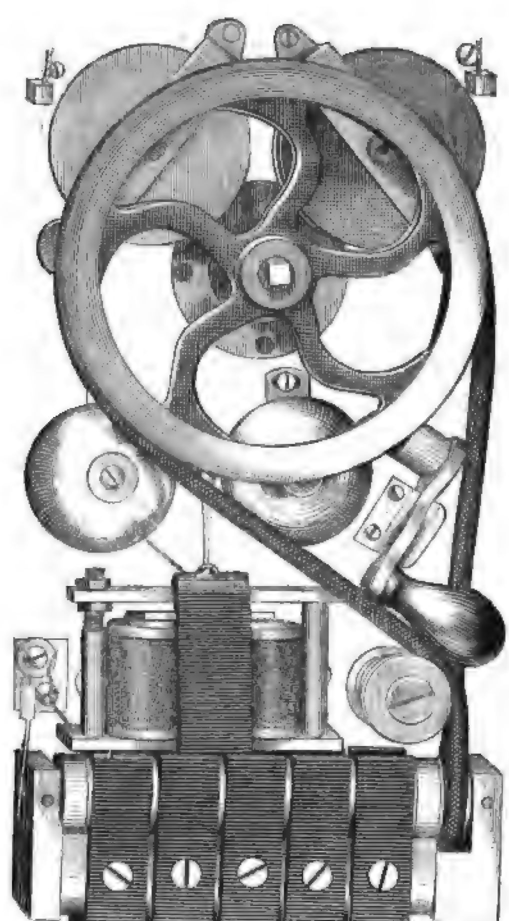
Fig. 6.

PORTABLE TESTING INSTRUMENT FOR ELECTRIC WIRES.

THE hazards attending the use of the electric light have been over-estimated; not in matters of number or magnitude, but because too little account has been given of the preventable nature of such occurrences. With every element in an electric lighting system adequately insulated, and the lights properly protected, accidents to person or to property are improbable. If these precautions are disregarded, only good luck will avert disaster.

Two contacts are necessary to divert electricity from an electric lighting system. If one contact already exists and connects it with the earth, only one more contact is necessary to conduct a portion of the electricity from the system.

In such an event, if the electricity meets with a conductor of sufficiently high resistance, the electricity is converted into heat sufficient to burn any combustible substance which



is present. Formerly, ground return circuits were used, but this proved hazardous, even with ample conductors leading to the ground, and has been abandoned.

If an electric lighting system is sufficiently insulated when first arranged, there is no assurance that it will remain so, on account of the numerous changes, blunders, and accidents to which it is subjected. It is necessary that each system should be equipped with some means of ascertaining the condition of the apparatus each day before the electric lights are used. Unfortunately we are not forewarned of any lurking disarrangement of electric apparatus by means of any of the senses, in the same manner that leaking gas appeals to the sense of smell, or as leaking steam produces sound and vapour.

Means for the systematic trial of the insulation of electric lighting plant is as necessary as the gauge cocks to determine the height of water in steam boilers.

The most satisfactory method is to determine the resistance of the insulation by means of galvanometer and rheostat. But this involves delicate and expensive apparatus which cannot be used by any except an electrician, and its use is therefore limited to central stations of electric lighting companies, and is not feasible to apply for practical use in isolated plants.

A telephone will give indication of ground connections, but there is no certain knowledge of the limit of its work, and it may deceive the operator, as it is liable to be affected by induced currents, or by grounds from other electrical instruments.

The best method is by means of a magneto, which generates an alternating current and rings a bell, like the ordinary telephone "calls."

The engraving shows a portable apparatus, devised by C. J. H. Woodbury, of Boston, Mass., for the purpose of inspecting electric light apparatus under his charge.

It was very desirable that it should be as small as possible, and yet generate a current of sufficient tension to indicate a possible leakage of a sufficient quantity of electricity to cause damage. It consists of a Siemens armature in the field of a battery of five permanent magnets. There is no commutator, and the alternating current excites an electro-magnet which vibrates a striker between two small gong bells, in the usual manner. A polariser over the electro-magnet removes any residual magnetism. In the circuit, at the end of the case, are two reels, each of which carries forty feet of steel ribbon with spring clamps at the ends. These reels and the wheel which revolves the armature by means of a quarter turn belt are turned by a crank which fits like a clock key, and when not in use is held by a spring clip, as shown in the engraving. The armature is wound with No. 38 wire, and measures two and three-quarter inches long and three-quarters of an inch in diameter. The whole apparatus is contained in a mahogany case four inches wide, an inch thick, and eight inches long, and weighs twenty ounces.

The bell will ring, when the magneto is working, through an external resistance of four thousand ohms. A similar instrument for use on longer circuits has larger magnets and an armature of greater diameter, and rings through a resistance of eleven thousand ohms.

It was supposed that on long circuits the surface of the conducting wires might act as a condenser, and the static charge ring the bell, but such has not been the case even with circuits containing six miles of No. 6 wire. This instrument has been in constant use for over six months.

[We are indebted to the *Electrician* of New York for advanced proofs of this article and also for the block wherewith we illustrate the description.]

THE ELECTRIC LIGHT IN PARIS.—Some very successful experiments on the electric lighting of the *foyer* of the Opera House by the aid of Faure accumulators and Swan lamps took place last week at Paris. It is the idea to light the whole house by means of from 600 to 700 lamps of this system. The lamps were first shown to the public on Friday, September 29th. They have been placed in several parts of the building, but most prominently in the *foyer*, the extremely elaborate decorations of which have been entirely spoiled by the ruthless effects of gas. To light the *foyer* with gas 10 chandeliers, with 48 lights on each, were used, equivalent to about 4,800 candle-power. Two of these chandeliers have been fitted with 48 Swan lamps each; these were run up to about 40 candle-power, making a total of 3,840 candles for the two chandeliers, almost exactly equal to the eight remaining gas-lit chandeliers. The effect in the neighbourhood of the electric light was exceedingly marked, and the representatives of the Opera House, who witnessed the trial, expressed themselves extremely pleased with the result. We may add all the main cables were covered with lead, and every lamp was protected with "cut-outs," to avoid any possible chance of fire. The illumination of the shop of M. Sandoz, the jeweller of the Palais Royal, has been discontinued, which will not be taken up again, at least under the circumstances. This illumination was made with accumulators charged at the works and carried to the Palais Royal. These unfavourable and une... tions are, we think, the cause of the dis... lighting. The Grand Café and the Th... continue their electrical illumination with

TO CORRESPONDENTS.

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CORRESPONDENCE.

TELEGRAPHING WITHOUT WIRES.

To the Editors of The Electrical Review.

Gentlemen,—With reference to the remarks that have been made by more than one of your correspondents upon my paper "On Recent Progress in Telephony," I think it right to say that I did not mean to imply that the experiment across the Solent was the *first* attempt to signal without wires across water, but that it was the first successful result obtained *by telephone*. In fact, I assisted Mr. Lindsay in 1854 in demonstrating the possibility of telegraphing across water in a large tank in the Electric Telegraph Company's stores in Lambeth, and I was aware that he had been anticipated by Vail in America, and, I think, also by Bain across the Serpentine.

Nor did I wish to assert that the very well-known fact of the lowering of the resistance of carbon by heat was a novelty, but that this effect was *one reason why* carbon is so much better than metals for microphones—an observation certainly novel, and derived from Mr. Shelford Bidwell.

W. H. PREECE.

DRY BATTERY.

To the Editors of The Electrical Review.

Gentlemen,—The perusal of a recent article upon the dry battery of Skrivanoff led to my calling upon Mr. Eldred, the courteous manager of the Globe Telephone Company, in Queen Victoria Street, who are the manufacturers. In response to my inquiry as to whether he could oblige me with a sample, he said they hoped very soon to be able to do so, and were confident of very good results. Noting my disappointment, he said he would give me one of those made in France, which were not so good as they would have shortly, if I would promise not to be disappointed results, and give it a bad name. I assured him I would and in a little he returned with what appeared rdinary electric bell push. It was a little heavier, but as all the difference apparent.

for the results of the rough tests I was able to apply. 'ng it to an electric bell of the ordinary type, it was ing very vigorously. It did the same through five istance—all I had at command then. It gave a ction on an ordinary Clarke's detector, with 10° for quantity. Desiring to try a more minute test, I cut a cross section-piece from an electric light carbon (Brush's), about 1-16th of an inch thick. Soldering a wire to it, and also to a piece of zinc of a similar size, I took a very small portion of the paste from the battery and placed between the two, covering the whole with paraffine wax. I at once had one of the tiniest batteries, which gave a deflection on the galvanometer of 50°. With it I have been able to take a rough test of the continuity of an electric light circuit during the past week, besides the tests of incandescence lamps, and the many little things that are hourly wanted. It appears as efficient now as when I joined it up, its compactness, and the certainty of not spilling and spoiling, being great recommendations.

If you were to make a sandwich of two great pieces, with a piece of note paper between, you would get a good idea of the size of this tiny working battery.

For tests at a distance from stations it will be a boon to inspectors and all who have like work to do; besides, it can always be carried in the pocket-book, ever ready for use.

Yours, &c.,

S. V.

NOTES.

Union of the Three Americas by Telegraph.—Panama, September 16th, 1882.—The cable steamers *Silvertown* and *Retriever* have returned and are now anchored in this bay, their work having been completed in the most satisfactory manner. The cable work and direction of the whole enterprise has been under the immediate care of Mr. Robert Kaye Gray, F.R.G.S., chief engineer representing the contractors, the India-rubber, Gutta-percha, and Telegraph Works Co., Limited, of Silvertown, London, England.

Mr. Joseph B. Stearns, a celebrated American electrician and the inventor of duplex telegraphy, is here representing the new cable company, whose title is the Central and South American Telegraph Company. Mr. Stearns, by the way, is well-known "at home" in Canada. His system is used by the Montreal Telegraph Company. He and Mr. Badger, of the Montreal Fire Telegraph Department, worked together before Mr. Badger left Boston to take up his residence in Montreal. Mr. Stearns has taken the position of general manager of the new enterprise *pro tem.* When all is complete he will hand over his charge to the president, and return to England, his present headquarters.

The cables laid by the *International, Dacia, Retriever,* and *Silvertown,* for the new company by the contractors' fleet, comprise some 3,200 miles of marine cable. The Central and South American Telegraph Company also have 313 miles of land lines working in connection with their cables as above.

The new company is American, and has its head offices in New York. The lines of the Mexican Telegraph Company run from Galveston, Texas, to Vera Cruz, Mexico, where the cable of the Central and South American Telegraph Company commences. The stock in both companies is nearly all held by the same shareholders. One president, Mr. James A. Scrymser, of New York, acts for both companies. The cables of the Central and South American Telegraph Company extend from Salina Cruz, in the Gulf of Tehuantepec, Mexico, on the Pacific side, to Lima, in Peru; there the cables of the West Coast of America Telegraph Company begin, and extend to Valparaiso, Chili, to be described later.

The connection of the Central and South American Telegraph Company with other ocean and land lines, will give a total mileage of over 20,000 miles, in Mexico, Central and South America, and with the Trans-continental line, an additional 6,250 miles, or in all 26,250. Here is a truly vast system of telegraphic connections just completed.

The three Americas are united by the cables of the Central and South American Telegraph Company for the first time. All honour to American enterprise.

Previous to the inauguration of the new company there was no direct communication by telegraph between these countries, as stated. For example, to send a message under the old *régime* to South America it had to be sent from New

York, *via* Newfoundland to England; thence by land lines and cables to Lisbon, Portugal, thence by cables to Madeira and the Cape de Verde Islands, and from the latter to Pernambuco, in Brazil. It will be seen that a message had to cross the Atlantic twice ere reaching the Atlantic coast of South America. Once there it could be sent up and down the coast by the cables of the Brazilian Submarine Company, from Para on the north, the neighbour of French Guinea, to Montevideo, in Uruguay, on the south; thence by a land line across the continent *via* Rosario, Mercedes, and Mendoza in the Argentine Republic, to Santiago and Valparaiso, Chili, thus reaching the Pacific or west coast of America, whence messages could be sent as far north as Lima by the West Coast of American Telegraph Company, an English corporation, whose manager is Edward William Parsoné. To fully illustrate how awkwardly people were placed in Panama and Callao when they had to cable to each other, the following will show. Let us suppose that A of Panama had to cable to B of Callao, distant only eight days by the English steamer. His message had to cross the Isthmus, thence to Jamaica, Havana, Key-West, to New York, thence *via* Newfoundland to England, over the Continent to Lisbon, from thence to South America, arriving at Pernambuco, thence *via* Montevideo across the Continent to Chili, thence up the coast to Callao, at an expense of nearly 13.00 dols. a word. It would have to travel over 14,000 miles of cable and 7,680 miles of land wire, in all nearly 22,000 miles—pretty well around the world. This was not only tedious and very expensive, but at times almost useless, owing to the land wires in South America being in a chronic state of "down," so that the mere paying for a message was often the easiest part of the whole affair. Such was not the exception, but the rule. Important messages often had to be sent on horseback across the wild pampas of South America. Now it is but fair to assume that under the new era these annoyances have been relegated to the past, and the Three Americas are in direct electric connection. Messages can be sent by either North or South America or the Isthmus of Panama, to Europe, or in a word, all over the inhabitable globe.

Now, how is all this done under the new order of things? Simple enough. A cablegram from either Mexico, Central or South America, on the Atlantic or Pacific side (in some places), can be handed into the office of the Montreal Telegraph Company "at home," or to any of the Western Union offices in the United States. It will then be forwarded direct to Galveston, Texas, thence by the cables and land lines of the Mexican Telegraph Company to Vera Cruz, Mexico, Atlantic side; thence it travels over the first section of the Central and South American Telegraph Company's cable to Goatzacoalcos a small Mexican village, situate at the mouth of the river of the same name, a distance of 138 miles, in the Gulf of Mexico; this section was laid by the contractors' steamer *International*, in March, 1881. The land line starts from Goatzacoalcos and crosses the Isthmus of Tehuantepec, a distance of 195 miles, and terminating at Salina Cruz, near the Mexican town of Tehuantepec, on the Pacific Ocean. Here the company are credited with having profited by the experience of the Western Union Telegraph Company, whose lines in the early days of telegraphy were of small wire, No. 16; these were often cut on the "wild prairie" by the gentle [illegible]avage of Uncle Sam's neglected family. A No. 9 or a layer [illegible]ire was then employed that was practically useless to the red skin. The Central and South American Telegraph Company here "give one better," by using a No. 8, a larger wire having a greater message capacity.

To return to Salina Cruz. It is the northern terminus of the Central and South American Telegraph Company on the Pacific, and from it the first section of cable runs south a distance of 435 miles to La Libertad, in Salvador. At the latter port the company makes its first connection with the telegraph system of Central America. The names of the Central Spanish-American Republics now in direct communication with each other are as follows:—Guatemala, Honduras, Salvador, Nicaragua, and Costa Rica. The second section extends to San Juan del Sar, Nicaragua, a distance [illegible] 2,694 miles, and from the latter place to the Island of [illegible]o Gonzales, the distance to the island being 671 miles. [illegible]land of Pedro Gonzales is in the Pearl Island group, [illegible]thmus of Darien. The Pearl Islands [illegible]er for producing the largest and most valuable pearls. The Isthmus of Darien produces—well, crocodiles, india-rubber, big trees, and a *fever* that has been celebrated since the days of Patterson's colony. The name of Patterson is well-known to English readers as the founder of the Bank of England. His famous Darien scheme received the Royal sanction in 1695. Patterson landed 1,300 men in Panama, nearly all Scotchmen, who proceeded to the Darien to found his New Edinburgh. Between fighting the Spaniards, destitution and fever, the little colony was all but "wiped out." History informs us that but thirty reached Scotland, and of them says "they were too weak to weigh the anchor of the vessel which was to carry them home, and had to be assisted in their departure by the Spaniards." *Vide* Macaulay *et al.*

From Pedro Gonzales Island a section runs in back of the island of Toboga, one to Brighton, a distance of 49·4 miles to the city of Panama. The landing of the cable here, and its having been buried in trenches on its way to the company's Panama offices, has already been referred to in the *Gazette's* Panama correspondence. At Panama it connects with the Panama Railroad Company's telegraph, across the Isthmus of Panama to Colon (*vel* Aspinwall) on Navy Bay, Atlantic side, thence by cables of the West India and Panama Telegraph Company, an English corporation, to all its important West Indian Islands, as well as with British Guinea or South America. Messages can also be sent by the same company *via* Cuba and Key-West to Europe, as already described.

From Pedro Gonzales Island another section of cable runs a distance of 358 miles to Buenaventura, where it connects with the land system of the Columbian Government, estimated at 3,000 miles, the objective point of the latter being Sante Fe de Bogata, or the capital of the United States of Columbia, an all but inaccessible place away up in the mountains, 8,000 ft. above the sea level. It is more than a "Sabbath day's" journey to our Paris.

From Buenaventura another section extends 486 miles to Santa Elena, in the Republic of Ecuador. Santo Elena is nearly under the equator, and is at the mouth of the Guayaguil river; the city of that name is 111 miles up the river, and is the principal port of Ecuador. A land line runs from Santa Elena to the city, also belonging to the Central and South American Telegraph Company. If the writer is not mistaken, this is the first telegraph line in Ecuador—another triumph for American push and investment. Strange to say, Old England sells the world their cables. We may say without fear of contradiction that England is the sole manufacturer of cables. It is true that there is a manufactory for them in France, but it is a branch house of the company who took this contract; English cable ships, English cables, Englishmen, English capital, and English skill are always to the fore. Our American cousins show their good sense in purchasing from our common parent what they cannot produce themselves.

From Santa Elena a section runs to Payta; its length is 222·019 miles. Payta, as the readers of the *Gazette* are aware, is the principal northern port of Peru, and possesses great commercial importance. A Peruvian land line extends from Payta to Lima, its capital. The latter is wretchedly uncertain (not the capital, the line), and constantly "ailing." To avoid all difficulties, the Central and South American Telegraph Company have added a final section of 552·9 miles to Chorillos, within a short distance of the capital. A land line of the Central and South American Telegraph Company, seven miles long, connects Chorillos with Lima. Lima is the southern terminus of the new company, and the northern terminus of the West Coast of America Telegraph Company, the cable of the latter, as already said, extends 1,699 miles to Valparaiso, Chili, touching the coast of Peru at Mollendo, Arica, Iquique and Autopogasta, formerly Bolivia's only seaport, thence to Caldera, Sarena, and Valparaiso. From Valparaiso a land line—that referred to—stretches across the vast continent, thus the Transandine Telegraph Company is a Chilian corporation. We, of the Pacific coast, thanks to the new company, can now send our messages to Europe by three different routes. If the cables and lines were clear, a message could be sent from your correspondent's office in Panama, around the world and back to himself in a very few minutes. It would travel some 26,000 miles *via* Chili and Uruguay to Europe and back *via* Montreal, Texas, and Mexico to the Isthmus of Panama.

The mind is all but dazed when one commences to contemplate what skill and capital are daily accomplishing in this great world. The tendency of the whole is to benefit mankind and advance civilisation. The millennial period of "plough shares, pruning hooks, &c.," is left for the future, as well as several letters on cables, cable ships, and cable laying, to be written in an everyday way for everyday readers.—*Montreal Gazette*, September 25th.

THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY'S CABLES.—The India-rubber, Gutta-percha, and Telegraph Works Company notify that the cables manufactured and laid by them for the Central and South American Telegraph Company between Vera Cruz, Mexico, Panama, and Lima, in Peru, with intermediate stations at Goatzacoalcos, Salina Cruz, Port Libertad, San Juan del Sur, Buenaventura, Santa Elena, Payta, and Chorillos, were opened to the public on Saturday, the 7th inst. These lines, some 3,200 miles, with the 1,700 miles of the West Coast of America Telegraph Company, extending from Lima to Valparaiso, with intermediate stations at Chorillos, Mollendo, Iquique, Arica, Antafogasta, Caldera, and la Serena, and the 740 miles of the Mexican Telegraph Company, between Vera Cruz and Galveston, with an intermediate station at Tampico, make 5,640 miles altogether, made and laid by this company between Valparaiso and the United States of America.

THE STEAM-SHIP "SILVERTOWN."—We read the following in the Panama *Star and Herald*:—

"Independently of the interesting fact that the *Silvertown* is a magnificent cable-ship, with all the necessary appliances and improvements used in laying the submarine telegraph lines, she is a comfortable and spacious vessel, having an elegant saloon, chastely furnished and cabins well ventilated, affording every comfort.

"During the recent earthquakes this fine steamer became the hospitable roof of many of Mr. Robert Gray's friends. The acting British Consul, with his family, as well as many English and French residents, during the panic had recourse to Mr. Gray's kindness, who most generously entertained them on board. The guests were taken from shore by the steam-launch of the *Silvertown* and received on their arrival by the officers and crew, who were most attentive. Several fine cabins were placed immediately at their disposal, amongst which Mr. R. Gray generously offered his deck-cabin and office, which had to be accepted. This cabin, ventilated to perfection, is most charming; it has a fine spacious berth, a library containing the latest books, newspapers, and periodicals, a bathing apparatus of no small dimensions, and several hammocks hung in different directions of the vessel to accommodate those who preferred reposing on deck and in the open air.

"Thus sleeping was assured with every comfort, as one can perceive, the victualling department provided the guests with everything that could be desired. The meals were thoroughly enjoyed by every one present, and the remarks made were that not only were they safe from falling *débris* and fright, but also that the benefit derived was surprising by the charming change and company.

"Now that the *Silvertown* is about to leave for San Francisco, where she will receive a cargo and return to England, it may be confidently assumed that the great scientific undertaking of laying the cables for the Central and South American Telegraph Company has been satisfactorily accomplished. Indeed, the employés on the *Silvertown*, and the operative staff of the company, are unanimous as to the admirable manner in which the cable has been laid—a fact which was proved by a final test which took place yesterday. The credit, of course, is due to the entire cable staff, under the guidance of Mr. Robert K. Gray, who has deservedly received congratulations from a large circle of friends at home and abroad. It is expected the lines will speedily be opened to the public for business, and then direct communication will be available to every town or port of importance north and south of the Pacific coast, and transmission to all parts of the world where lines are laid—a boon which cannot fail to be appreciated by the public at large. It is a fact that signals through 1,600 miles of direct cable have been exchanged with remarkable distinctness.

"The offices at the various stations along the company's route are all in readiness for work. The Panama office, which, we understand, is to be the head-quarters of the Central and South American Telegraph Company, has been rapidly transformed into a suitable set of offices since the arrival of the traffic manager (Mr. C. J. Murphy), who, in conjunction with the general manager, Mr. J. B. Stearns, has been most assiduous in making necessary alterations for the public benefit, and who has also an efficient staff of operators ready to carry on the work of the office."

TELEGRAPHIC INVESTMENT COMPANIES.—The London *Times* of Wednesday, in a leader, says: By some investments of money, whether the subscribers gain or lose, the world must profit. Among speculations of this infallible kind the enterprise of the Central and South American Telegraph Company and the Mexican Telegraph Company ranks high. They are companies doing business at New York, and under American management. No State aid has been granted or, so far as we know, been solicited by them. Out of their own resources, and in reliance on calculation of returns which there is no ground to presume will prove untrustworthy, they have spent nearly a million sterling in filling up the gaps in South and Central American telegraphy. At Callao, the port of Lima, the telegraphic chain up the west coast of South America has hitherto terminated. To the imagination of the engineer and to the practical judgment of the merchant, the huge stretch northwards with the Republics, long ago deserted even by financiers, has been a wilderness isolated from civilisation. Last spring the steam-ship *Silvertown* started with several thousands of miles of potential lungs and voices for the inarticulate shores of the Pacific. The operation is already accomplished. The rill, as it were, of South American utterance falls into vast and loquacious sea of Western Union telegraphy, which spreads it over the univere. Intercourse among the South and Central American States has been confined hitherto chiefly to war. The populations which inhabit them have had no easy avenues of communication, and have felt no especial desire to construct them. Telegraph stations, uniting at a multitude of points, will tempt them to an acquaintance which may lead to friendship.

NEW CABLES.—We have reason to believe that the Great Northern Telegraph Company are making the necessary preliminary arrangements for the duplication of all their cable lines in the Far East, to be effected at a very early date. This to meet more readily the exigencies of the increased Chinese and Japanese traffic, both local and international.

CABLES INTERRUPTED.—The cable between Guadaloupe and Dominica is interrupted. There is at present no telegraphic communication with the islands of St. Lucia, Martinique, St. Vincent, and Barbadoes.

CABLE REPAIRED.—The cable between Amoy and Hong Kong is repaired.

TELEGRAPH CABLE SHIP FOR THE POST-OFFICE.—We learn that Messrs. David J. Dunlop & Co., Glasgow, have contracted with the Post-office authorities for a cable ship.

TELEGRAMS FOR JEDDAH.—The Post-office gives notice that a cable has been laid between Souakin, in Egypt, and Jeddah, in Arabia, and that telegrams can now be accepted for transmission to Jeddah.

ELECTRIC LIGHTING.—The *Athenæum* says: "Among other improvements about to be made at the National Library at Paris, it is hoped that the electric light may be successfully introduced."

THE Peterhead Police Commissioners have resolved that the electric light shall not be supplied to their town by any company. They are the owners of the gas works.

THE *Newcastle Daily Chronicle* says: "The electric lighting at the Tynemouth Exhibition is now perfect."

THE electric lighting of the galleries of the Dundee Fine Art Exhibition is a great success.

THE Hamilton Town Council at their monthly meeting had before them notifications from three electric lighting

companies. They resolved to meet specially on Thursday to consider whether the burgh should not apply for an Order.

THE Conway Town Council have agreed to inform all electric lighting companies that they are fully prepared at the proper time to oppose applications for Provisional Orders to supply the electric light within their jurisdiction.

THE New York correspondent of the *Standard*, telegraphing on Sunday evening, says: "The danger caused by the current of electricity escaping from the underground wires has excited much comment of late, and a fire which occurred in a suburban church is attributed to this cause. Mr. Edison asserts that his household system has proved an entire success, but the remark is made that the loss of the current has prevented his service being supplied to more than fifty houses."

THE following letter from the Town Clerk of Glasgow was read at the Town Council meeting on Monday: "The Gas Committee, acting under remit from the Town Council, have resolved to recommend to the corporation to apply for a Provisional Order to enable them to supply electric lighting to the city. This recommendation will be considered at a special meeting of the Council to be held on the 19th inst. In the meantime I am in communication with the town clerks of Manchester and other burghs in England, with a view to joint action on an uniform basis, to resist all applications by outside electric lighting companies, and to promote the requisite order in as complete a form as possible on an uniform basis."

THE Pollockshields Commissioners have remitted the several notices on electric lighting sent them to the Lighting Committee, and declined to give an opinion on the matter at present.

THE Rutherglen Town Council have passed the letters addressed to them by electric lighting companies to their Lighting Committee for consideration.

THE Broughty Ferry Commissioners at their monthly meeting, on Monday, had before them a letter from the secretary of the Northern Electric Light, Power, and Appliances Company as to supplying electric light. The clerk was instructed to reply that the commissioners intended to move in that direction themselves.

A COMMITTEE of the Salford Town Council, on Monday, decided to recommend the Council to consider the expediency of adopting a resolution authorising and directing an application to the Board of Trade for a Provisional Order empowering the Corporation to supply electricity for public and private purposes within the area of the burgh; and, further, to direct the Town Clerk to give a month's notice pursuant to the Electric Lighting Act, 1882, for the purpose of considering the applications of various companies for Provisional Orders, and to oppose or support the same, as the Council may determine.

A MOTION proposing that it be remitted to the Lord Provost's Committee to consider whether the Council already possesses power to supply electric light, or whether supplementary powers be sought, was unanimously adopted by the Edinburgh Town Council at their meeting this week.

THE BRUSH ELECTRIC LIGHT.—At a fancy bazaar held on the 5th, 6th, and 7th, in the Kinnaird Hall, Dundee, four Brush arc lamps of 2,000 candle-power each were hung from the roof of the hall, diffusing a powerful light on the quaint scene below, which was a representation of a Swiss village market-place. The roofs of the huts were coated with white wood, to give a winter appearance to the spectacle, and the light was well reflected through the entire hall, owing to this. Outside the door, suspended from ornamental brackets, were another two lamps, the light of which illuminated the greater part of Bank Street, and attracted much attention from the passers by. Every one that saw the lights seemed highly satisfied with their brilliancy and steadiness, and were of opinion that the Brush system would take well in Juteopolis. The installation was fitted up by the Brush Electric Light and Power Company of Scotland, Limited.

LECTRIC LIGHTING AT CHESTERFIELD.—It will be embered that we fully described the electric lighting of Chesterfield, as far as it had then been accomplished, in the ELECTRICAL REVIEW of April 15th. The following letter appeared in the *Standard* of last Thursday: "At this time, when the question of lighting by means of electricity is receiving so much attention, and as Chesterfield is the only town in England whose lighting is done throughout by electricity, it may be interesting to your readers to know what our experience has been.

"I need not detail the stages which led to our abandoning gas, and taking up the electric light after being in darkness some months. I may briefly state that, after going carefully into the question, we decided to adopt the system whose praise was in every one's mouth a year ago, namely 'The Brush,' and, though we were applied to by other companies, we placed the execution of the work in the hands of the one that we considered the most suitable—the Hammond Company. During the negotiations of the contract, Mr. Hammond particularly pressed us not to stipulate for incandescent lamps, as he acknowledged that their company were not in a position to cope with incandescent lighting for public purposes. We, however, decided upon the town being lighted with the Lane-Fox incandescent lamps, as well as the Brush arc lights.

"After waiting many weary months for the completion of the incandescent lighting, it is now, when declared by the contractors complete, in my opinion a decided failure. The Lane-Fox lamps, which have been supplied by the Brush Company, are most variable in their lighting power; whilst some are good, others only give a feeble light instead of a light equal to that of fifteen candles, as expected. The arc lights are doing good service in some of the large streets, but as a whole I think it has been fully demonstrated in a year's trial in Chesterfield that the field for arc lighting is very limited indeed.

"Though the tradesmen have been canvassed by the Hammond Company with a view to introducing the arc lights into their shops and hotels, in not one single case has the light been adopted. Indeed, it is evident to us who have them under our eyes every night that they are only fit for lighting works and large open spaces. The experience that has been thus gained at Chesterfield at the present juncture must be of value to all towns intending to adopt the electric light, and is my reason for troubling you with this letter, although I believe the time will shortly come when lighting by electricity may be advantageously adopted both for public and private purposes.

"GEO. EDWD. GEE, Alderman of the Borough of Chesterfield."

TWO ESTIMATES FOR INCANDESCENT ELECTRIC LIGHTING:—Lancashire Maxim-Weston Company:—

2,000 lamps	£500
Renewals (? per ann.)	500
Dynamo machines	4,000
Engines	2,500
Cable	1,000
Fittings and extras	500
	£9,000

The "Ferranti" system:—

1 Dynamo machine	£1,200	
2,000 lamps	500	
Sockets for above	100	
Speed Indicator	6	16
Packing, fixing, erecting, instruction, &c.	300	
	£2,106	16

Steam-power is not included here, nor the cost of cables, but taking the high figures for these items as given in the Maxim-Weston Company's estimate, we must add to the above £3,500, making a total of £5,606 16s. 0d., as against £9,000 for precisely the same work.

SHEFFIELD AND THE ELECTRIC LIGHT.—We hear that the Corporation of Sheffield has decided to undertake both the public and private lighting of this important town by means of electricity; and an application for the necessary powers will be made to Parliament as early as possible in November. Mr. Conrad Cooke, so well known through his connection with our contemporary, *Engineering*, the recent telephonic law-suits, electric lighting, and scientific matters generally, has been appointed consulting engineer and scientific adviser

to the Corporation. It would be hard to find a gentleman more thoroughly conversant with electric lighting than Mr. Cooke, he having been practically connected with the subject since the first "Gramme" dynamo-electric machine was brought to this country. The preparation of the elaborate scheme upon which he will shortly be engaged, should the matter of lighting Sheffield by electricity be carried through, as no doubt it will, is no *light* task; and we congratulate Mr. Cooke on his being selected for this most important work, feeling assured that it will redound to his own credit, as well as ensure the success of the undertaking.

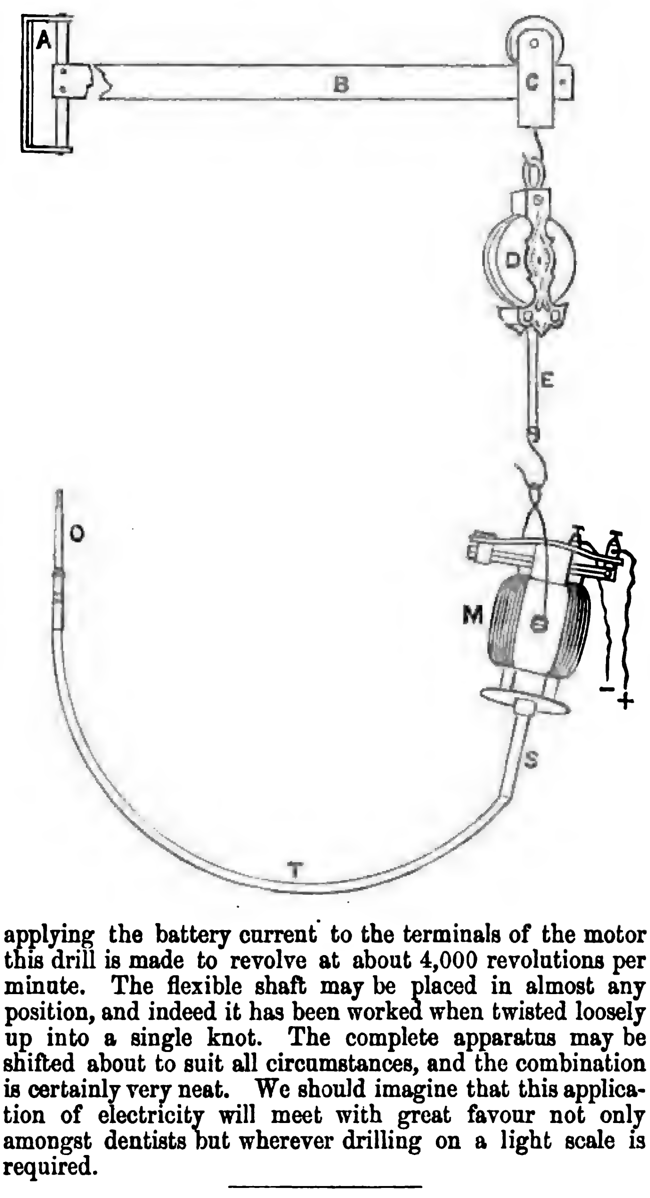
ELECTRICAL ENGINEERING.—Classes for instruction in electrical engineering are to open on the 23rd inst. at the works of the Railway and Electric Appliance Company, Polmadie. Mr. Rankine Kennedy is to conduct the classes.

THE OWENS COLLEGE, MANCHESTER.—Professor Arthur Schuster, assisted by Mr. W. Haldane Gee, will give a theoretical and practical course on the technical applications of electricity, including the first principles of Electrical Engineering, on Thursday evenings, from seven to nine o'clock, in the Physical Laboratory. The following is a short syllabus of the class, which may, however, be subject to some variations. Measurements of current, electromotive force, and resistance. Current producers: the Daniell, Grove, Bunsen, Leclanché, &c., elements. Standard cells, how to prepare. Current measurers: the vertical detector, the astatic galvanometer, differential winding, the tangent and sine galvanometers, Thomson's reflecting galvanometers. Units of resistance: the B. A. and Siemens units, manufacture of cheap resistances, arrangement of resistances in coils. The exact measurement of resistances. Condensers. Construction of telegraph lines, measurement of current, localisation of faults, testing of insulation and conductivity. Duplex telegraphy. Submarine telegraphy: the tests during the construction of the cable. Telephone, microphone, induction balance. Magneto and dynamo-electric machines, description and comparison of different systems. Electrical lighting: testing of strong currents and electromotive forces, different systems of lamps. Photometers. Description of electro-motors and electric railways. The class will have at its disposal a Wilde dynamo-electric machine, which when worked by the college engine may be arranged to produce either direct or alternate currents. In the electric light measurements students will have the opportunity of personally using instruments of recent design, such as those of Professors Ayrton and Perry, Sir William Thomson, and Dr. Siemens. The fee for the class is £2 2s. Students desiring to attend are requested to communicate as soon as possible with Professor Arthur Schuster, at the college.

ELECTRICAL EXHIBITION.—The Electrical Exhibition at the Westminster Aquarium, which it is now arranged shall be opened on December 1st, is, we are informed by Mr. Gooch, likely to be a great success. The entries of motors, to which just now public interest seems attached, will be large and interesting. Electric light entries are also numerous and representative. The matter of distribution seems to have received attention, and the different systems will find many exponents. The Edison electric light will form a very attractive feature as usual.

LIGHTNING CONDUCTORS.—The Lancashire and Yorkshire Railway Company have, through their telegraph superintendent and engineer, received specifications and estimates for new lightning conductors for their carriage works at Newton Heath, and decided to use the system for which Messrs. James Davis & Co., of Bradford, received the prize medal at the Crystal Palace International Electric Exhibition, 1882.

THE GRISCOM MOTOR.—An exceedingly useful application of this motor to dental operations may be seen at the London office of the Electro-Dynamic Company of Philadelphia. The engraving shows the general arrangement of the apparatus. A wall-bracket, A, carries a movable beam, B, along which a travelling roller, C, may be pushed to any desired extent. This roller carries a little circular case, D, precisely similar to an ordinary spring tape measure. From a brass tape, E, is suspended the Griscom motor, M, which may be adjusted to any position. On the end of its axle a flexible steel wire shaft, T, is coupled by means of a connecting piece, S. At the end of T is the drill, O, and on



applying the battery current to the terminals of the motor this drill is made to revolve at about 4,000 revolutions per minute. The flexible shaft may be placed in almost any position, and indeed it has been worked when twisted loosely up into a single knot. The complete apparatus may be shifted about to suit all circumstances, and the combination is certainly very neat. We should imagine that this application of electricity will meet with great favour not only amongst dentists but wherever drilling on a light scale is required.

THE COERCITIVE FORCE OF STEEL RENDERED PERMANENT BY COMPRESSION.—This is the title of a very interesting paper, presented by Mons. L. Clémandot to the Académie des Sciences on the 2nd of October. The result obtained by M. Clémandot is as follows: When steel is tempered by compression, that is to say, when it is cooled under pressure after a quick cooling, obtained partly by compression, the coercitive property of steel is maintained, notwithstanding the reheating and even forging; it is permanent and indelible whatever be the subsequent operations to which it is submitted. Whilst steel tempered in a bath is hard, unworkable, and often distorted, compressed steel can be worked up again as if it were soft; it can be filed, drilled, &c., which is an inestimable advantage for manufacturers of magnetic apparatus, magneto-electric machines, telephones, &c., who often lose valuable time by working upon magnets which break at the last moment. M. Clémandot's paper seems to us to have a special bearing, and it would be very important to know if steel prepared by his method really possesses the permanence which the author attributes to it; we could, if it is so, construct ampèremeters and voltmeters with permanent magnets, whose constancy and exactness would leave nothing to be desired. We hope that the Commission charged with the examination of the researches of M. Clémandot, and composed of MM. Dumas, Boussingault, Fremy, Debray, and Breguet, will not delay its opinion upon this important question.

[illegible] taken up and £[illegible] [illegible] paid amount to £[illegible]

[illegible] (LIMITED).—The nominal [illegible] 100 shares of £500 [illegible] made up to August 28th, was filed on [illegible] The whole of the shares have been taken [illegible] per share has been called. The call has been met to the extent of £10,000, leaving £2,500 unpaid.

ANGLO-[illegible] ELECTRIC LIGHT, TELEPHONE, AND POWER COMPANY (LIMITED).—The return, made up to the [illegible] was filed 9th inst. The nominal capital is £300,000, in £[illegible] shares, but the seven shares taken by the signatories to the memorandum and articles of association are [illegible] at present issued.

BIRMINGHAM AND WARWICKSHIRE BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The [illegible] return of the company, made up to the 3rd inst., was registered on the [illegible] inst. The capital is £100,000, in £2 shares. 37,841 shares have been issued and £2 per share called. The calls paid amount to £30,428 10s., and considered as paid to £45,000, leaving £253 10s. of calls unpaid.

NEW PATENTS—1882.

4717. "Dynamo and magneto-electric machines and electro-motors." J. GORDON and J. GRAY. Dated October 4.

4718. "Improvements in and connected with electric railways, which improvements are in part applicable to other electrical purposes." J. HOPKINSON. Dated October 4.

4735. "Secondary batteries." C. F. KINGZETT. Dated October 5.

4738. "Meters for recording quantity of electricity." A. E. PORTE, J. LESWARE, and J. CHANCELLOR. Dated October 5.

4740. "Call apparatus for telephone lines (switches, armatures, magnets, &c.). M. BENSON. (Communicated by J. P. Stabler.) Dated October 5. (*Complete.*)

4752. "Intensifying fluorescent or phosphorescent electric lighting, whereby the same is rendered serviceable for illuminating purposes, and apparatus for effecting the said intensification. R. KENNEDY. Dated October 6.

4756. "Secondary voltaic batteries." A. KHOTINSKY. Dated October 6.

4764. "Electrical apparatus for the propulsion of boats." A. RECKENZAUN. Dated October 6.

4768. "Covering wire for electrical purposes." J. J. C. SMITH. Dated October 7.

4771. "Production of electric light and means to be employed for the purpose." O. G. PRITCHARD. Dated October 7.

4777. "Mechanism or apparatus for electrical communication on railways." R. TATHAM. Dated October 7.

4778. "Telephones." H. B. T. STRANGWAYS. Dated October 7.

4780. "Electric lamps or lighting apparatus." S. F. WALKER and F. G. OLLIVER. Dated October 7.

4787. "Machines for moulding pipes or tubes from plastic material and for covering telegraph cables or the like." J. H. JOHNSON. (Communicated by G. F. Lufbery.) Dated October 7.

4809. "Secondary batteries." R. TATHAM and A. HOLLINGS. Dated October 10.

4810. "Dynamo-electric machines." R. E. B. CROMPTON and G. KAPP. Dated October 10.

4816. "Voltaic batteries." E. J. WIMSHURST. Dated October 10.

4819. "Dynamo, or magneto-electric machines." W. R. LAKE. (Communicated by J. Wenström.) Dated October 10.

4824. "Incandescent lamps used for the purpose of electric lighting." E. MULLER. Dated October 11.

4829. "Electric switch for electrical lamps and other purposes." G. W. BAYLEY. Dated October 11.

4832. "Telephones." J. H. JOHNSON. (Communicated by L. de Locht-Labye.) Dated October 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

941. "Electrically controlling, &c., the speed of engines, &c." J. RICHARDSON. Dated February 27. 6d. This invention relates to certain improvements connected with the invention patented by the inventor on the 22nd day of January, in the year 1881, No. 288, for apparatus for controlling and regulating the speed of engines employed in driving dynamo machines. According to the present

FIG. 1.

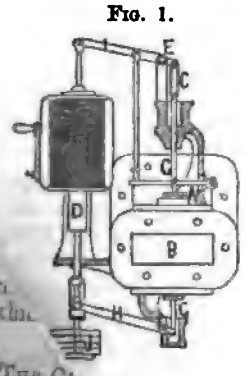


FIG. 2.

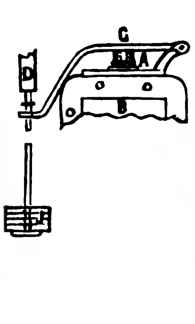
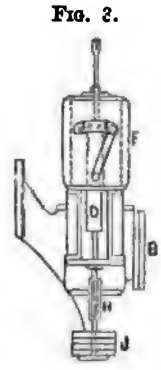


FIG. 3.



[illegible], shown in front and end elevation respectively by figs. 1 [illegible] the solenoid is connected with the valve, B, by fixing the [illegible] under the valve to draw the valve downwards instead of [illegible] down and thus get the stalk, G, of the valve in tension [illegible] compression; by this means its diameter and therefore its [illegible] the stuffing boxes is very much reduced. This thin stalk, G, is made of steel or of phosphor bronze, and is carried upwards through the stuffing box, A, connecting its upper end by means of a flexible cord or a steel band, C, either to the arm, E, of a lever (upon the long arm, I, of which is hung a weight, J, or passed round a pulley on the opposite side of which is hung a weight), or it is connected directly to a strong spiral or other spring, the object being to lift the valve upwards to open it in opposition to the force of the solenoid tending to close it. Simple means are also used to prevent the engine chasing, thus dispensing with the second electro-magnet now used for that purpose, utilising instead the weight of the core of the solenoid, to which core is attached a brass rod and balance weight, as at fig. 3.

1002. "Electric rotary hairbrush." H. LEESNER. Dated March 2. 2d. The inventor constructs the axle upon which the brush turns of wood or any other suitable substance; this axle is covered with leather or other suitable substance; the axle is constructed of larger diameter than those in the ordinary revolving brushes. The cylindrical frame upon which the bristles are fixed is constructed of vulcanite or other suitable dielectric substance or substances. On the inside of the frame of the brush are suitable grooves, and into these grooves are fitted metal wires. These wires are carried to the outside of the frame of the brush into grooves on the outside of the frame of the brush, where they are insulated. The ends of these wires are brought up among the bristles and, preferable, the ends terminate at about half the length of the bristles. The friction caused by the revolution of the brush on the axle sets up a current of electricity which is conveyed by the embedded metal wires to the ends of the wires among the bristles, and thus brought into contact with the hair. (*Provisional only.*)

1017. "Insulating apparatus for overhead telegraph lines, &c." J. S. LEWIS. Dated March 3. 6d. The object of this invention is to produce an insulator to which the wires shall be easily, quickly, and effectually affixed, and consists in forming the top of the insulator in the shape of a screw gradually expanding in its diameter, something after the manner of a gimlet end only with a more rapid increase in diameter. To this the wire is fixed by means of a metal shackle or clip of stout round wire, formed in the shape of a horse-shoe to fit round the insulator and having a hook at either end to fasten round and clamp the line-wire. By hooking this shackle on to the wire and screwing the screw formed on the (loose) insulator into this ring till it is tight, and then fastening the insulator bolt tight on the telegraph arm or bracket, the wire is secured. Fig. 1 is elevation of

FIG. 1.

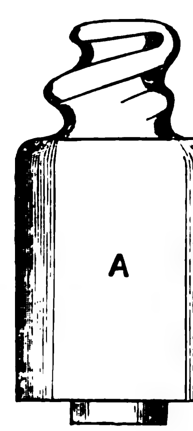
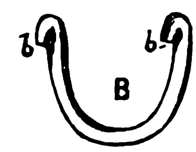


FIG. 2.



insulator and fig. 2 shows the shackle or clip for attaching the wire thereto. In these A is the insulator, B the shackle or clip, *b* hooks on shackle B. In fixing telegraph wires the line-wire is attached to the insulator by means of the shackle or clip, shown in fig. 2. The hooks, *b*, pass round or hook on to the line-wire, and enclose the insulator, A, between the wire and the partial ring formed by the shackle, B. By turning the insulator (which is left loose in the arm on the telegraph post or bracket) round and screwing it into the ring thus formed (the screw being a gradually expanding one, as shown) the insulator is wedged tightly into the ring. The insulator can then be rigidly fixed in position by means of a bolt or stud cemented into and projecting from it in the ordinary manner. The patent also relates to the method of forming the screw on the insulator.

1020. "Apparatus for transmitting and receiving sound." J. RAPIEFF. Dated March 3. 6d. For the purpose of increasing the distinctness and intensity of transmitted sounds, the inventor proposes to use a microphone having two or more groups of contacts, parts or branches, arranged in such a way that the vibrations set up by the sound-waves in one or several of these groups will increase or decrease the pressure of the contacts, and consequently decrease or increase their resistance, while the contrary effect will be produced in the contacts of the other group or groups, and he connects these different groups of contacts, parts or branches of the microphone to separate wires, or parts of the primary coil or coils of an induction bobbin, in such a way that the effect of a divided current from a battery, passing through this arrangement of microphone's contacts and primary coil or coils, when the microphone is at rest, shall produce little or no magnetisation of the iron core in the induction bobbin. The result of this arrangement will be that when the sound-waves or vibrations act on the microphone, the added, or double effect of the changes of the microphone's contacts, pressure, and resistance will produce a differential action of the current on the primary coi'

coils, and consequently will effect a greatly intensified variation of the magnetisation of the iron core and the induced currents in the secondary coil or coils of the induction bobbin. For obtaining the same result any similar disposition of the microphone's contacts in connection with the induction bobbin can be used, as for instance, the groups of the microphone's contacts may be inserted in the sides of a Wheatstone bridge, while the primary coil or coils of the induction bobbin are placed in the bridge itself.

1023. "Indicating and regulating the current of electric generators." T. J. HANDFORD. (A communication from abroad by T. A. Edison, of America.) Dated March 3. 8d. The object of a portion of this invention is to produce devices to be used in connection with dynamo or magneto-electric machines and electric lights, which will notify the engineer when the lights are above or below the desired limit of candle-power, so that he can regulate the generative capacity of the machine or machines in accordance therewith, and also to produce other devices which will prevent injury to the machine or machines when an abnormally large current is caused to flow by the addition of more lights than the plant has capacity to furnish, and will at the same time notify the engineer of the condition of affairs. It consists principally of a relay in a shunt circuit, whose tongue plays between two contacts. An increase in the current deflects the tongue against one contact and rings a bell, whilst a decrease in the current deflects it against the other contact and rings the same bell through a resistance, producing a feebler sound.

1024. "Construction and working of switch apparatus for telegraphic or telephone exchanges, &c." W. E. IRISH. Dated March 3. 8d. Relates to certain improvements in or connected with the construction and working of junction or switch apparatus specially applicable for use in telegraph or telephone exchanges or stations, or for other similar or equivalent uses in which it may be desired to put any one or more of a number of wires speedily in connection or electrical continuity with any other or others thereof for telegraphic, telephonic, or other similar or equivalent purposes or uses—are, to simplify the construction and arrangement mechanically and electrically of the means by which this object can be obtained, and to greatly reduce the number of parts required, to avoid all complexity in the arrangement thereof, so that the operation of effecting the required connection may be expedited and more simply effected than as hitherto, and so that the operation of the apparatus may be rendered more reliable and accurate.

1029. "Incandescent electric lamps." F. WRIGHT and M. W. W. MACKIE. Dated March 3. 6d. Relates to the construction of the bulbs of electric lamps, and means of attaching the fibres to their conductors in a simple and durable manner. In forming the bulb with the conducting wires the inventors proceed as follows:—The inventors fix on a tube by means of spun glass the two conducting wires which have the carbon fibre attached to them. The tube with the wires on it is inserted into the tubular throat of the bulb, and then by heating the tubular throat it is caused to collapse on the tube and wires, closing them in hermetically. The end of the inner tube is drawn out to a small bore, and forms the passage for extracting air from the bulb. By heating the throat of the bulb, and pushing the inner tube in, the throat is caused to fold inwards on itself, so that the point of the inner tube is in such a position as to be protected by the external throat of the bulb projecting beyond it. For attaching the fibre to its conductors the inventors first thicken the ends of the fibre by coating them with syrup, and then carbonising the sugar of the syrup by application of sulphuric acid. The thickened ends of the fibre are inserted into tubular pieces of platinum, formed by bending the ends of platinum strips into tubular form, and the platinum is tightened on the fibre by a washer of steatite enclosing it.

1031. "Vacuum pumps for exhausting bulbs of electric lamps, &c." F. WRIGHT and M. W. W. MACKIE. Dated March 3. 6d. Relates to vacuum pumps for exhausting the bulbs of electric lamps or other vessels in which great rarefaction of air is required, the object being to provide in simple and compact form for utilising the barometric column of mercury as a seal for the outlet of

FIG. 1.

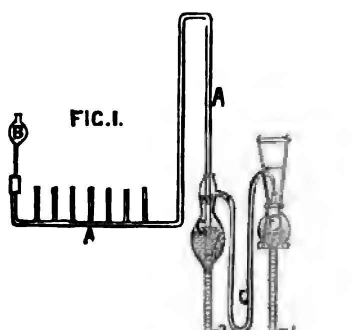
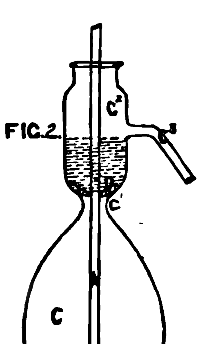


FIG. 2.



the discharged air. Fig. 1 shows an elevation of one arrangement of the apparatus. A is a tube having a number of branches, on which are temporarily secured in an air-tight manner the bulbs, or ... be exhausted of air. The tube, A, after ascending a ...re than 30 inches, descends again, and enters the vacuum ... which it descends some distance, as shown, and being ...lower end, has a small lateral opening or openings, A^1, formed in it, as shown more clearly in the enlarged view at fig. 2. The vessel, C, has a narrow neck, C^1, through which the tube, A, passes, and above which it is expanded into a cup, C^2. The tube, A, carries a caoutchouc washer, D, that closes the neck, C^1, as a valve, and the cup, C^2, above it is partly filled with mercury, acting as a seal. The vacuum vessel, C, has a tube, C^3, extending down more than 30 inches, and connected by a flexible tube, E, to the tube, F^1, of a vessel, F, filled with mercury, and supported so that it can be raised and lowered to a certain extent. The vessel, C, and tubes, C^3, E and F^1, being also filled with mercury, it will be seen that on raising the vessel, F, the mercury will also rise in C, thereby forcing the air in its upper part out through the valve, D. On again lowering the vessel, F, the mercury in sinking in C will cause air to be drawn from the bulbs, B, through the tube, A, and opening, A^1, into the vacuum thus formed in the upper part of C, and this air will be again expelled through the valve, D, on causing the mercury to rise in C by raising the vessel, F, again, the opening, A^1, being closed by the mercury, so as to prevent any escape of the air back into the tube, A. The above operation of causing the mercury alternately to descend and ascend in the vessel, C, being repeated, the air will be gradually exhausted from the bulbs, B, to any required degree. The cup, C^2, has an overflow branch, C^4, connected by a flexible tube, G, to the mercury vessel, F, so that any excess of mercury can flow back from C^2 into F.

1034. "Galvanic chains." C. D. ABEL. (A communication from abroad by L. A. Kraehmer, of Dresden.) Dated March 3. 4d. According to the present invention galvanic chains are constructed as follows:—A zinc plate and a copper plate are secured on opposite sides of a piece of cloth or felt of corresponding shape, the metal plates having for this purpose a series of holes through which and through the cloth or felt are passed silk cords or threads so as to secure the three parts together, forming thus a link of the chain. The zinc plate has projecting at one end a loop, and the copper plate has projecting from the other end a hook, or *vice versâ*, and the several links being placed so that the copper plates alternate on each side with the zinc plates, the zinc plate of the one link is connected by its loop to the hook of the copper plate of the contiguous link on the one side, while the copper plate of the said link is connected to the zinc plate of the contiguous link on the other side, the connections thus forming hinge-like joints, enabling the chain to fit in any desired position. To the end links of the chain are by preference attached single zinc and copper plates, respectively serving as electrodes for making contact with the part of the body to which the chain is applied. The copper plates are by preference gilt to prevent oxidation. When in use the cloth or felt is impregnated with suitable liquid for maintaining an active galvanic current.

1036. "Manufacture of carbons for electrical purposes." H. LIEPMANN and P. S. LOOKER. Dated March 3. 6d. Refers to the manufacture of carbons from materials as hereafter described and their subsequent treatment so as to render them of a high density and suitable for the production of electrodes and other electric candles and filaments, whether they be rods, tubes, plates, lumps, discs, filaments, or otherwise suitable for electrical and other purposes. For the purposes of the invention the inventors employ the material known in commerce as the "corosso," or ivory nut, or vegetable ivory, or its clippings, turnings, or filings, or a material or materials of an analogous nature. The nut may be used without the shell or the two may be combined, or the shell may be used alone for filaments; the material is subjected to destructive distillation, or the material is carbonised in any other convenient manner either by heat or by the action of acids so as to leave the carbon produced therefrom in as pure or partially as pure a state as may be. The nuts or other materials as aforesaid may be used alone or in combination with other materials such as sugar, resins, oils, and essences or their equivalents, capable of producing a substantially pure product. When the "corosso," or ivory nut, or material before referred to has been subjected to destructive distillation a light and heavy liquid goes over; this distillate may be treated separately to get other products, or it can be utilised to mix with carbon obtained as described to form a pasty mass alone or with other materials.

1054. "Telephonic apparatus." N. K. CHERRILL. Dated March 4. 4d. Relates to methods of producing and utilising what are called and known among electricians as "undulatory" currents of electricity, and to applying the same for the purpose of transmitting signals or sounds to a distant station by means of a "line-wire" or other electrical conductor, as is now commonly employed in electric or telephonic signals. The inventor forms a flat spiral of wire which may be single, double, three or more fold. The same may be attached to a diaphragm in such a manner that it will be free to vibrate by the action of sound, or it may be so constructed as to vibrate without a diaphragm, and he then so adjusts the said diaphragm and wire, that the said vibrations may be made across the lines of magnetic force of either a permanent or electro-magnet, and he uses the currents generated in the said spiral coils for transmitting the electrical impulses to a distant station for the purpose of there ...ating signals by electric or magnetic induction, either by instru...nts already known and used, or by novel adaptations to be herea... described, or by duplicates of the transmitting instruments. (*Prov...*

1139. "Dynamo or magneto-electric machines." T. J. HA... (A communication from abroad by T. A. Edison, of Amer... Dated March 9. 6d. The object of this invention is such ... improvement upon electrical generators and engines of the Pacinot... type, that the inactive portions of the bobbin will have a greater cro... sectional area, and a lower resistance per unit of length than t... active portions, so that the internal resistance of the machine wil... reduced to the minimum. The object is accomplished by fo... the bobbin coils of bars, which extend on the outside of th... annular core, parallel or nearly parallel with the axis of rot... of wide plates on the inside of the ring, the bars and p... connected to produce a continuous bobbin by radial end ...

CITY NOTES, REPORTS, MEETINGS, &c.

THE ANGLO-AUSTRIAN (BRUSH) ELECTRICAL COMPANY (LIMITED).

The first general meeting of shareholders of the above-named company was held at the company's offices, 4, Copthall Buildings, E.C., on Tuesday, Sir William Stephenson, K.C.B., in the chair. Mr. Wm. Thompson, secretary, having read the notice convening the meeting, the Chairman said: Gentlemen, the present meeting is convened in accordance with our statutes which require that the first general meeting of the company should be held within four months after registration. I need hardly remark that it would be inexpedient at the present stage to enter into details regarding a good deal that the board is doing for establishing the company's business, but there are several matters on which the shareholders would probably like to be informed, which I will take this opportunity of communicating to them, and I also wish to say a few words regarding the general policy the board is pursuing. In the first place, as regards the company's capital, I may inform you that 26,668 ordinary shares were subscribed by the public in response to the prospectus we issued. I have also to inform you that a modification was agreed to by the vendor in the arrangement with him, by which he accepted for the patents transferred by him, only £27,000, instead of £55,000, in cash on account of the total sum of £75,000 due to him. The balance of the purchase money he accepted in 5,600 shares fully paid up, and 8,000 shares credited with £2 10s. per share paid up. By this modification the company has a larger proportion of its subscribed capital available for developing the business than if the original mode of paying for the patents had been adhered to. With regard to the business of the company, you are aware that we possess the Brush and Lane-Fox patents for Austria and Hungary, together with certain advantages in connection with same in Roumania, where no patent laws at present exist. So far as concerns our articles of association, however, we are at liberty to carry on business in any other country. I think I need not dwell upon the merits and commercial value of the Brush system of electric lighting, which have been amply proved by the substantial results obtained in the United States and in England, but I may state that we have satisfied ourselves that a large field exists in Austria, Hungary, and Roumania for which this class of lighting is suitable, and I may add that Brush lights are already in use at the present time in several manufactories in Austria. But whilst we believe that the development of the Brush system in its proper field will prove a highly remunerative business in the countries referred to, we are satisfied that the development of a system of distribution of electrical energy for domestic lighting and other purposes will prove a business of vastly greater importance. It is not so long ago that it was considered a great feat to operate 15 or 20 lights from one dynamo machine, and it is only a very short time ago that an enormous stride was considered to have been made when some of the streets in the City were lighted up by means of Brush lamps operated by a machine in Lambeth, and the Opera House in Paris was lighted up by means of Brush lamps operated by a machine placed in the Exhibition Building in the Champs Elysées. But to-day, the talk is not of 30, nor 40, nor 50 lights, but of thousands of lights operated from central stations, and it is not light only that we look to obtain from these central stations, but we expect them to supply us with heat and power; we expect to get our dinners cooked, our hair brushed, and our boots cleaned by these central stations. In fact, it is now realised that it is possible to lay on electrical energy to houses in a town, like water or gas, with the main conductors always charged for consumers to draw on at any hour of the day or night. This is the problem we now have to face. Now, the possession of the Lane-Fox patents gives this company advantages in connection with this part of the business which I believe it would be difficult to over-estimate. I wish to dwell especially on this matter, both on account of its importance to the company, and because this part of Mr. Lane-Fox's invention is hardly known or appreciated, being applicable to a degree of advancement in electrical engineering which we are only now reaching. Although I do not profess to be a technical man, the matter has been made so clear to me, that I think I can undertake to explain it. Mr. Lane-Fox appears to have conceived from the outset the idea of a general system of distribution of electrical energy. Dynamos, accumulators, and lamps were then in their infancy, but he foresaw the degree of perfection to which they would probably be brought; and whilst others were applying themselves to the improvement of matters of comparative detail, he, taking a bird's eye view of the whole subject, applied himself to the study of how he could link together the various elements he saw growing into shape so as to constitute the comprehensive system of distribution of electrical energy which he had conceived would be necessary to make electricity a commercial possibility. The result of his labour was the particular part of his patent to which I now refer and which sets out a combination of dynamos, accumulators, and incandescent lamps or other apparatus, by means of which the main conductors in the system of distribution of a district can be kept charged with electrical energy at a constant pressure, which can be drawn upon at all times for use in suitable apparatus to produce [illegible] heat, power, or other effects. Now, it is very important to [illegible]stand what this patented combination really covers. We pro[illegible] most of us, have a general notion of the offices which would [illegible]formed by the dynamos, accumulators, conductors, and lamps [illegible]neral system of electrical distribution in a town. We have a [illegible] idea that the current is generated by the dynamos when put [illegible]tion by steam-engines or other motors, that the accumulators [illegible] the duty of reservoirs into which the dynamos pump the [illegible] force, and from which the lamps can draw the supply they [illegible] and when required. But it is perhaps not so generally [illegible]d, at any rate by the public, that the various patents one hears of for dynamos, accumulators and lamps only cover details of construction, and that the fundamental ideas on which they are based are practically public property. I mean to say that the production of an electric current by mechanical action is not a patent; that the process of storing electricity by utilising the chemical effect of the electric current on certain substances is not a patent, and that the production of light by heating to incandescence in vacuo a filament of carbon, or other substance, is not a patent. All this can be effected more or less efficiently and economically by means of apparatus which is not patented, as well as by a great variety of patented apparatus; but dynamos, accumulators, and incandescent lamps, whether patented or unpatented, cannot be used in combination as a system except under Mr. Lane-Fox's patent. The question then arises, Can a system of distribution be established without using dynamo, accumulators and lamps combined, in the manner patented by Mr. Lane-Fox? On this point I am advised that although it is possible to feed the lamps direct from the machines, as has been commonly done hitherto, without the intervention of accumulators, it would be found, in a general system of distribution, that the difficulty of regulating the current to meet a varying demand, the additional cost which would have to be incurred to put down plant and machinery capable of meeting the maximum demand at any time, added to many other disadvantages, would practically put such an arrangement out of the field. It would be like attempting to supply water to a town without the intervention of reservoirs or gas without the intervention of gasometers. It amounts to this, therefore, that Mr. Lane-Fox's patent practically covers the distribution of electrical energy on a large scale. I understand that in London alone, with its 4,000,000 inhabitants, at least 30 millions of pounds sterling are invested in the gas industry, and this will enable us to form some conception of the business which may be developed when electricity comes to be laid on like gas, from house to house, and I think therefore it will be admitted that I was correct in the remark I made just now that I believe it is difficult to over-estimate the value of a patent like Mr. Lane-Fox's, which places us in such a pre-eminently favourable position to introduce a general system of distribution of electrical energy. This question of the development which the application of electricity is likely to take consequent upon the establishment of systems of distribution brings me to another point, viz., the position this company should assume in relation to the business to be created. Austria, Hungary, and Roumania contain together a population of over 42 millions of souls. A large proportion of this population no doubt is not in a position for local reasons to avail themselves of our electrical energy, and possibly a further proportion may have the bad taste to prefer electrical energy supplied by others than ourselves. But assuming that one-tenth part only of the population comes to us for electricity, it is obvious that it would be far beyond the powers of our company or indeed of any single company to undertake the working and administration of the systems of electrical distribution which even the above-mentioned small fraction of the country would require. Moreover, there are many reasons why the working of the systems of electrical distribution should be in local hands. In the opinion of the board the position this company should take is that of pioneer, in the first instance, and afterwards contractors and manufacturers, for the establishment of the systems of distribution which we believe and expect will result from our pioneering. The programme of operations determined on by the board in pursuance of this policy is to set up manufacturing works in Vienna forthwith, and at the same time to lay down a system of electrical distribution on a sufficiently large scale to demonstrate the practical and commercial possibility of the scheme. When this first test system is in satisfactory operation and it is known that our works are in running order, that we possess a properly organised staff, and that generally we can be depended on both in point of skill and responsibility to contract for the establishment of systems of distribution and also for their maintenance and the repair of apparatus, we believe that the formation of local companies to own and work under our licences systems of distribution for different towns and districts will not be a matter of difficulty. Of the practical success of the installations the board feels confident, and of the commercial success they feel equally sanguine in countries where the price of gas varies from 5s. 4d. to 12s. 8d. per 1,000 cubic feet. Now you will probably wish to know something of what we have done so far towards the realization of our schemes. On this point, although, as I mentioned before, I am obliged in the interests of the company to speak with some degree of reticence, I think I can say enough to satisfy you that the board has not allowed the grass to grow under its feet during the short space of time that has elapsed since the company was launched. In the first place we have secured in Vienna temporary premises, in which we are commencing our manufacturing operations pending the completion of negotiations for the purchase of one or other of two buildings, either of which is in every respect suitable for our permanent requirements. We have ordered in England a large number of machine tools for our factory, and many of them are already on their way to Vienna. The nucleus of our staff in Vienna is formed and is now engaged in organising our works. A committee of the board, consisting of myself and two directors, has just returned from a tour in Austria, Hungary, and Roumania, where we have been engaged in making general arrangements for carrying on the company's business. An important contract is being negotiated for the lighting of one of the principal buildings in Vienna, to form part of our first system of distribution. Negotiations are also proceeding for the sale of licences for certain districts, and an agreement has been signed for the conditional sale of the licence for one important district. The board is, however, very strongly of opinion that the sale of licences should not be pushed until the company is in possession of a working organisation and manufactory capable of meeting the requirements of licensees. On the success of the subsidiary companies depends, in the opinion of the board, the real success of our company, and we think it would be shortsighted policy for the sake of immediate re-

turns to part with licences, at present, which must become of much greater value so soon as the satisfactory working of our first installation has established our name. The committee, therefore, rather directed its efforts in Austria to securing the co-operation of persons of influence under an arrangement by which a participation is to be secured to them in the benefits which we shall derive from the formation of local working companies, in consideration of their contributing to the expenses of the experimental installations, and affording us their support in our operations. I am happy to say that satisfactory progress is being made in the matter. In Roumania, the committee had the honour of several interviews with the King, who showed the greatest interest in the question of electric lighting. His Majesty has given us orders to light up experimentally his Winter Palace, and the grounds of his Summer Palace at Bucharest. He has also given us the order to put down the leads for a system of distribution in his palace of Sinaia in the Carpathians, and the estimates for the permanent lighting of this palace by electricity are under consideration. The staff for carrying out the above work is on the spot, and some of the apparatus for Bucharest has already arrived and is in course of erection. The whole of the remainder is on its way out. The initiative taken in this matter by their enlightened, liberal, and enterprising sovereign bids fair to secure to the Roumanian people the prestige of being the first nation in the world to adopt and reap the benefits of a comprehensive system of distribution of electrical energy. Before concluding, there is one more matter to which I wish to refer, although it is one on which it will probably be necessary to call you together again. We have now in hand, as you are aware, business in Austria, Hungary, and Roumania. The two former countries, although under the rule of a common sovereign, are essentially distinct and separate. All these countries are desirous that their enterprises should bear the stamp of their own nationality, and although they are all disposed to view with favour the introduction of a business from England, it is not a recommendation in the eyes of the two latter that the name of Austria should appear in the title of our company to the exclusion of their own. Furthermore the board is of opinion that the name "Brush" in the title of the company, besides being extremely difficult to translate into a foreign language in the sense in which it stands, is rather misleading having regard to the development which the Lane-Fox patents are likely to take in the hands of this company. Under these circumstances the board is of opinion that it would be advantageous to the company to alter its title so as to bear a less distinctive character in respect of nationality and system. We think that some such title as the "International Electrical Company, Limited," would be more suitable, the more so as we have business in view in another country concerning which I hope to be able to give you some account when we meet again to settle the question of the alteration of our name. I trust that what I have said will satisfy you that the board is giving its earnest attention to your business. I shall be happy to afford further information should anything I have said not be quite clear, but at the same time I beg you to remember, should you ask me any questions, that information on matters of detail is of far greater use to your competitors than to you.

No questions being asked, Mr. Trevor proposed a vote of thanks to the chairman and the directors, and the proceedings terminated.

Brazilian Submarine Telegraph. — The directors recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended the 30th June, 1882, and also a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the past year. A balance remains of £51,295, of which amount £50,000 has been placed to the reserve fund, increasing that fund to £407,663, and £1,295 carried forward. The above dividend and bonus will be payable on the 28th instant.

Reuter's Telegram.—An interim dividend at the rate of 5 per cent. per annum has been declared for the half-year ended 30th June last, payable on the 14th instant.

Eastern Extension, Australasia, and China Telegraph.—The accounts for the half-year ended 30th June last show a net profit of £113,393, against £94,755 for the corresponding period of 1881. After providing for two quarterly interim dividends and a bonus of 1s. per share, making together 3 per cent. for the half-year, and charging against the half-year's revenue £30,000, the balance of cost of the Singapore-Batavian cable, there remains £23,468 to be carried forward.

West India and Panama Telegraph.—The accounts for the six months to 30th June last show a balance of £12,621 on revenue account. After placing £5,000 to reserve the directors have decided to carry forward the balance of £7,621. In consequence of the unusually heavy cost of repairs to cables during the past and current half-years, the directors are unable to recommend a dividend on account of the arrears of dividend on the preference shares.

The Submarine Cables Trust announce that the coupons due on the 15th inst. will be paid on and after that date by Messrs. Glyn, Mills, Currie & Co. They must be left three days for examination.

The Globe Telegraph and Trust Company announces the payment of an interim dividend for the quarter ending 18th October of 3s. on the preference shares and 2s. on the ordinary shares.

The Direct United States Cable Company (Limited) state that the interest due on the 15th inst. on their six per cent. debenture loan will be paid on and after the 16th inst. at the Consolidated Bank, Threadneedle Street, E.C., where coupons should be left for examination three clear days before applying for payment.

Application has been made to the Committee of the Stock Exchange for a settling day and quotation on behalf of the Anglo-Austrian Brush Electrical Company (Limited) shares.

Directors of Electric Light Companies.—Mr. J. Irving Courtenay and Lieutenant-Colonel F. G. Steuart have retired from the board of the Hammond Electric Light and Power Supply Company (Limited).

Direct United States Cable Company.—This company notifies that the interest due on the 15th inst. on their six per cent. debenture loan will be paid on and after the 16th inst. at the Consolidated Bank.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Oct. 11.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	13¾-14¼	14.13¾.14.13¾.⅞.14.14⅛ ac.
		Do. Do.	10	28 - 32	28¼.9 ac.
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1½- 2	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1½- 1¾	1½ ac.
25,000	5	Great Western Electric Light & Power Co.	2½	1 - 1½	1 7/16 ac.
24,980	5	Hammond Electric Light & Power Supply Co.	2½	7½- 8	7½.⅝.¾.⅝.½ ac.
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1 - 1½	1¼.1 ac.
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅝- ⅞	11/16 ac.
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1¾- 2¼	
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2½	2¼.3/16 ac.
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	50 - 51	50½.1 ac.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	82½- 83½	83.½ ac.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19½- 20½	20½ ac.
130,000	10	Brazilian Submarine, Limited	10	11¾-12¼	12¼.in. 12⅜.⅛ ac.
16,000	10	Cuba, Limited	10	9¾- 10¼	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 6¾	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	16 m.
65,000	20	Direct United States Cable, Limited, 1877	20	12 - 12½	12 5/16.¼.3/16 ac.
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10¾- 11	10 13/16 ac.
70,000	10	Do. 6 per cent. Preference	10	12¾- 13¼	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	102 -105	
300,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	101 -104	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½- 11¾	11½ ac.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	{Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan 1900}	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9¾- 10¼	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6⅝ ac.
163,209	10	Do. 6 per cent. Preference	10	12¼- 12¾	12½ ac.
125,000	10	Great Northern	10	12¼- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	30½- 31½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	1¾- 2¼	
8,200	10	Do. 8 per cent. Preference	10	8 - 9	
9,000	8	Reuter's, Limited	8	12½- 13½	
280,000	Stk.	Submarine	100	250 -260	
58,225	1	Do. Scrip	1	2⅛- 2⅜	
4,200	Cert.	Submarine Cables Trust	100	103 -106	
37,350	12	Telegraph Construction and Maintenance	12	30½- 31½	30⅞.1½ ac.
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -104	103½ m.
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 4¾	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	6¾- 7¼	7 ac.
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,600	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	7½- 8	
4,669	10	Do. 6 do. 2nd do.	10	6½- 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	1 1/16 ac.
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	¼	¾- 1	
100,000	5	United Telephone Co.	5	10½- 11	

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company (Limited). The number of messages passing over the lines of this company during the month of September was 2,464, estimated to produce £2,250, against 2,024 messages, producing £2,030, in the corresponding month of last year. The June receipts, estimated at £2,900, realised £2,951.

The Direct Spanish Telegraph Company (Limited). The estimated traffic receipts for the month of September, 1882, are £1,812, as against £1,790 in the corresponding period of last year.

The Eastern Telegraph Company. The traffic receipts for the month of September, 1882, were £57,271, against £47,407 in the corresponding period of 1881.

The Eastern Extension Telegraph Company. The traffic receipts for the month of September, 1882, were £32,955, against £30,866 in the corresponding period of 1881.

The Great Northern Telegraph Company. The traffic receipts in September, 1882 were £21,280 from the 1st January to 30th September, 1882, £181,840, in the corresponding months of 1881, £180,279, and in the corresponding months of 1880, £176,646.

The West Coast of America Telegraph Company (Limited). The traffic receipts for the month of August, 1882, were £3,400, against £3,185 in the corresponding period of 1881.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending 30th September, 1882, were £2,360; and for the week ending 6th, October, 1882, were £2,626, both after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 256.

ELECTRICAL ENGINEERING IN ENGLAND.

During the present year vast strides have been made towards the establishment of centres of technical instruction in what must now be looked upon as the absorbing topic of the day. Although previous to this there were many places where students might acquire a good knowledge of electrical work, amongst other subjects, we think we may say without fear of contradiction that two years since there were not more *special* classes or schools of instruction in matters electrical than could be counted on the fingers of one hand. Now it would require a little thought to enumerate the manifold centres of education where technical instruction in electrical engineering is made a speciality. Beginning with London, we may at once say that we do not know of a more suitable place for a student to acquire that which is not always sufficiently taken into consideration in many technical classes, viz., an elementary knowledge of electricity and magnetism, than by a course of study in the classes of the Birkbeck Literary and Scientific Institute. Many of our younger and well-known electricians have, to our knowledge, gained much valuable information by the good and patient teaching, and the numberless experiments performed before the students of these classes by Mr. Wilson and his assistants. Then we have, amongst others devoted to the complete education of an electrical engineer, the School of Telegraphy and Electrical Engineering, which has, perhaps, been established a greater number of years than any others of an important character.

Better known than all, and probably more fully attended, are the classes of the City and Guilds of London Institute. We have now before us a programme of the technological examinations (1882-83) of this college, together with the papers set in the examination for 1882, which form a very interesting study; and if the questions herein set had been correctly, or even fairly, answered by the students under examination, the result would have shown great proficiency in the pupil and teaching ability which does not fall to the lot of all professors of science, for oftentimes a clever scientist may fail utterly in the endeavour to explain his views to others. We are under the impression, however, that the questions dealing with electrical matters did not show any extraordinary acquirements on the part of the pupils generally, and we are inclined to think that this may be due partly to the want of the elementary knowledge of electricity and magnetism as a starting-point, and partly to the fact that professors of deep learning in the subjects they teach may not be able to descend sufficiently into a simple and forcible way of addressing a mixed assemblage so as to enable them to convey clearly and indelibly their lectures to their hearers. At King's College, Prof. W. Grylls Adams has established special classes for instruction in electrical engineering, which will doubtless be taken full advantage of. It may not be out of place here to mention that Mr. St. George Lane-Fox, one of the most successful inventors in "electric lighting," was formerly a pupil of Prof. Adams. The "Hammond" College, which has recently been opened, will also be of considerable service in the cause of electrical science, but its operations will be limited to the supply of competent electricians to the "Hammond" Electric Light Company and its off-shoots. In the country, instruction equal to that obtainable in the metropolis is provided in several towns. Bristol and Glasgow have each its university and classes presided over respectively by Prof. Silvanus Thompson and Mr. Andrew Jamieson, C.E., and both gentlemen are well known in connection with the latest developments of electrical engineering.

Manchester, following the example of these towns, comes prominently forward with the Owens College classes, conducted by Prof. Arthur Schuster and Mr. W. H. Gee. Until recently the impression that the profession of an electrician did not offer much attraction, and that it was already overdone, had a deal of truth in it, but this is no longer the case. The demand for competent men is at present certainly greater than the supply, and electrical may now be compared to railway, engineering, in its early days. Never did a subject present greater attractions and inducements to the student than that on which we have made these observations, and we have little doubt but that the centres of instruction we have alluded to will have their resources severely taxed. We notice in the Report of the City and Guilds of London Institute that "any person desiring to form a class for instruction in any technological subject, with a view to these examinations, should apply, as early as possible, stating his qualifications, to the Director and Secretary of the Institute, Gresham College, E.C."

We are not aware whether such classes as exist at the Birkbeck are to be found in the school of the City and Guilds Institute, but if not it would surely be worth while to start such classes as an introduction to the more advanced studies taught by Prof. Ayrton and others.

ELECTRICAL APPARATUS FOR STOPPING STEAM ENGINES.

At the beginning of the week we paid a visit to the offices of Messrs. Duncan Bros., engineers, of 32, Queen Victoria Street, for the purpose of inspecting Tate's patent electric valve-closing apparatus. As will be readily surmised, the object of the invention is to automatically close the valve of a steam-engine, and therefore stop it; and to do this in the quickest possible manner the inventor has had recourse to a very simple electrical expedient.

We cannot do better than use nearly the same description of the apparatus as that given by Messrs. Duncan Bros.

The apparatus is shown in fig. 1, and consists of an ordinary Leclanché battery (two cells), not given in the drawing, an electro-magnet, and wires leading to any position from which it may be desirable to control the engine, and press buttons for completing the circuit. Also a small steam cylinder, piston, and rack and pinion gearing, which actuates the stop valve on the engine.

The electro-magnet is placed at the top and connected, as may be seen more plainly in fig. 2, to a suspension rod which actuates a small steam cock on the cylinder of the apparatus. When it is desired to put the apparatus in operation, the pressure of the finger on one of the buttons —at any distance from the engine—closes the circuit,

excites the electro-magnet, and causes it to lift its armature and release the suspension rod, which falls with a velocity due to its own weight. The suspension rod in falling opens the small cock on the cylinder and admits steam, the initial pressure of steam being the same as in the steam-engine cylinder. The piston in the cylinder of the apparatus immediately ascends and the rack piston rod instantly closes the engine stop valve.

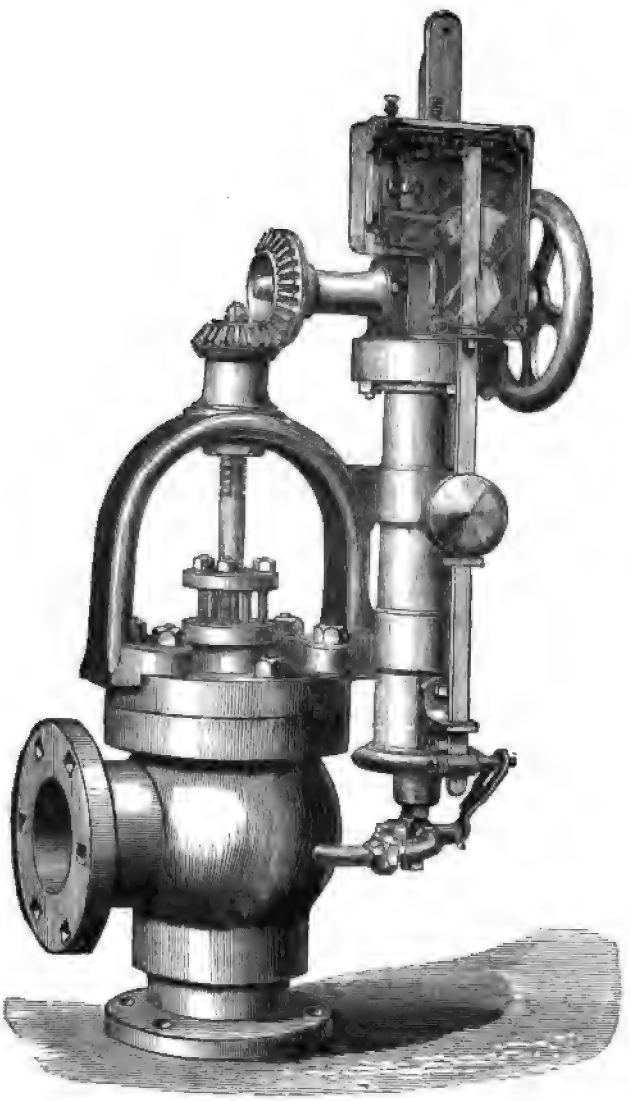


Fig. 1.

The steam to work the apparatus being taken from the stop valve chamber from underneath the valve—*i. e.*, between the valve and the steam-engine cylinder—the consequence is that as soon as the stop valve has been closed there is no longer any pressure in the small cylinder; and when it is desired to start the engine, the engine-driver has simply to lift up the suspension rod to its normal position and open the stop valve in the ordinary way. In lifting the suspension rod the small cylinder cock is again closed against the admission of steam, but the cock having three passages is opened for the inlet of atmospheric air. The act of opening the stop valve by the hand wheel operates also on the piston, which falls to the lower end of the small cylinder and is then reset for further use.

When applied to the stop valves of condensing engines, a cock fitted on a pipe opening to the atmosphere is also actuated by the apparatus, and at the instant the stop valve is closed this cock is opened, thus admitting air into the condenser, destroying the vacuum and stopping the supply of water.

The apparatus also stops the engine on which it is fitted whenever the speed exceeds the ordinary rate by any given number of revolutions. This is effected by means of the throttle, or variable expansion valves, actuated by the engine governor. Short arms are fixed on the valve spindles which act as fingers to press in a push or button at any time the valve exceeds the usual range of lift or stroke.

By looking at fig. 2 the action of the apparatus will be much more clearly seen. The suspension rod, E, is held in position by the tooth in the locking-piece, D. The cam-shaped piece, C, is kept back by the end of the armature, A, which is lifted when a current is passed through the electro-magnet, M. When this occurs, C falls over by its own weight, and striking a projection on the back of D, knocks this locking-piece away, and the suspension rod thereupon falls and performs the operation assigned to it. As far as the parts of the apparatus directly actuated by the electric current are concerned, they are of the most simple character, and there is apparently nothing liable to get out of order. It is oftentimes very important that engines shall be quickly stopped, and we cannot conceive a more simple or more effectual way than that devised by Mr. Tate. It is stated that this invention "brings within the reach of any person

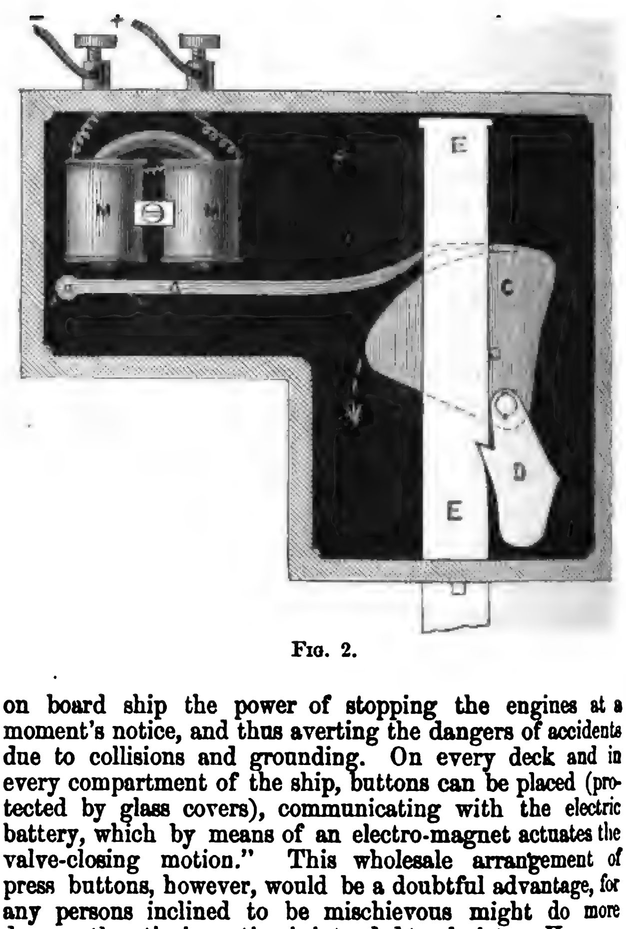


Fig. 2.

on board ship the power of stopping the engines at a moment's notice, and thus averting the dangers of accidents due to collisions and grounding. On every deck and in every compartment of the ship, buttons can be placed (protected by glass covers), communicating with the electric battery, which by means of an electro-magnet actuates the valve-closing motion." This wholesale arrangement of press buttons, however, would be a doubtful advantage, for any persons inclined to be mischievous might do more damage than the invention is intended to obviate. However, we take pleasure in bringing to the notice of our readers an apparatus at once so simple and useful, and we feel sure that its numberless advantages will be apparent to all, without any further explanations from us.

THE MANUFACTURE OF SUBMARINE CABLES.

Up to the present time it may be said that the manufacture of submarine cables has been entirely confined to England, and for years to come we may maintain our supremacy in this kind of electrical engineering; but there are not wanting indications, which although now but faint, appear to point to competition at some future date from another country. Our readers have doubtless perused in our "Notes" columns an account of the cable recently laid by the Baltimore and Ohio Telegraph Company across the Narrows at the entrance of New York Harbour. Although this was but 2,200 yards in length, diameter $2\frac{1}{4}$ inches, and weight 3,600 pounds, certainly insignificant enough when looked at from one point of view, but very suggestive from others, it shows, in combination with several minor matters of the same character, that our American cousins have seriously at heart the development of cable manufacturing in their own country.

Indeed it is surprising that such an undertaking should have been so long delayed in that part of the world where everything else connected with electrical science is carried on with such energy. A writer in the *Montreal Gazette* says in an article on the successful completion of the submersion of the Central and South American Telegraph Company's cables:—"Our American cousins show their good sense by purchasing from our common parent what they cannot produce themselves." The author of this remark certainly does not flatter his neighbours, but we fancy he is not far from the truth nevertheless. Cable work is quite unlike any other kind of industry, and our monopoly of this branch of electrical engineering is the result of dearly bought experience. It has been brought to such a state of perfection here, that it would scarcely be a profitable venture to start cable making manufactories on a large scale in America or any other country, unless it was a branch establishment of an English company, such as that of Persan-Beaumont, France, which is an extension of the India-rubber, Gutta-percha, and Telegraph Works Company.

It is necessary to consider that in the existing English factories the cable-making machinery of the present day is much the same as that which was in use long ago with but slight modifications, and therefore its first cost may be looked upon as having practically vanished, and need not be taken into account in estimating the cost of manufacturing a new cable, as would necessarily be the case if a foreign competitor entered the field with everything entirely fresh. What applies to the cable works may be also considered in regard to the cable ships. The constant practice and experience of English manufacturers enables them to complete any lengths of submarine cable in the shortest possible time and at the smallest possible cost. But this is not all. It is necessary that the cable shall be both mechanically and electrically perfectly sound, and such conditions can only be obtained by the aid of skilled electricians, who have spent a number of years in carefully watching the various points, electrical and mechanical, which go to ensure the perfection of a completed cable. This portion of the contract can be successfully performed by the staff on shore; but the most difficult performance of all has yet to come. The submersion of long cables taxes the ability of electricians and submarine telegraph engineers in the highest degree, for to lay a long cable from shore to shore without any hitch or fault occurring either in its mechanical or electrical conditions is a feat, the successful accomplishment of which may well be regarded as an achievement to be remembered with pride.

Had a fault occurred in the short American cable of which we have spoken, or had it been lost altogether, it would have been a matter of small moment; but conditions are entirely altered in these respects when we have to deal with lengths of 1,000 and 2,000 knots. We need not comment upon the result of a fault breaking out in such lengths as these. In every detail of cable manufacturing we have the lead of all other countries, and it would assuredly take many years for America to compare with us even in manufacture; and as our contractors have the confidence of the entire world, we must conclude that the chief construction of submarine cables will always be held by England. It is only necessary to point to the latest exploit of the India-rubber and Gutta-percha Company to show the perfection which has now been attained in cable work, from the preliminary survey of the course and ocean's bed to the complete submersion of the cable. Mr. Robert Gray, the company's engineer-in-chief, is to be congratulated on the successful finish of a great undertaking, and also on the ability and skill of his assistant electricians. The laying of the Central and South American Company's cables has still further increased the Silvertown Company's reputation, and it is not perhaps too much to say that never was an undertaking of such magnitude carried out with fewer drawbacks. We have kept our readers well informed concerning this most interesting expedition, and we hope to place before them at the proper time an exhaustive account of the entire proceedings.

A New Cable.—According to the *Times* of the 17th inst., a new submarine cable will shortly be laid between France and Senegal.

KERNER'S BURGLAR ALARM EXCHANGE SYSTEM.

The use of electricity for domestic purposes is much greater in America than in this country; in fact the progress which has been made in England has practically been nothing to speak of. Even the use of electrical fire alarms has only been effected under great difficulties, and the encouragement which this form of apparatus has received has not been by any means great. Simple forms of electrical burglar alarms, although mentioned in the catalogues of every electric bell manufacturer, have practically never come into use; whilst the more elaborate applications of this form of signalling apparatus, which are to a considerable extent employed in the United States, are never dreamt of for use in any English town. Possibly now that electricity is coming so prominently into public notice some of its applications to domestic purposes may receive more attention than has hitherto been the case, and we think that its application for the protection of property should receive careful consideration.

The American Kerner Electric Burglar Alarm Company have closed a contract with the District Telephone Company of New York for the right to use this system in New York and Brooklyn, and this recent adoption is made after exhaustive trials of other systems, which have proved total failures in one way or another.

In selecting a system for any purpose, the one that has been most carefully worked out in all its details and which appears most likely to best answer the purpose required, should be the one selected for practical use. In describing the system which Mr. Marion Harrison Kerner has devised for the protection of property from burglarious attempts, we think that we are bringing to notice a system which has been most carefully considered and which can effect all that is claimed for it. By this system a bank vault, warehouse, shop, residence, safe, or any property, movable or immovable, may be made thoroughly burglarproof in the following manner:—

1. Bank Vaults.

The interior walls of the vault are arranged with a system of conductors, either of tinfoil or sheet-copper in such a manner that any attempt to penetrate them with any kind of tool will disturb the circuit and cause an alarm to be rung at a central station or exchange where a staff of servants is held in readiness to respond thereto. There is no alarm whatever sounded at the bank, and no indication made to the burglar that he has unknowingly alarmed the central station, and so he proceeds in his project until surrounded and captured in his depredatory act.

The entrance to the vault is arranged with a duplicate door of any design, constructed of wood and paper and arranged with invisible electric conductors and appliances for carrying a current of electricity through them when closed, so that the door cannot be opened or cut through, nor any portion of the vault entered without an alarm being instantly given at the central station or exchange.

2. Safes.

In the case of jewellers' safes or, in fact, any kind of safe, a cabinet of any desirable design is constructed and placed around the safe, and this is done in such a way as to make it an ornament to the room. The cabinet may be constructed as follows: The frame work is of any kind of wood, and the panels may be either of wood or paper to match. The framework is protected by wires imbedded in the wood, and leading thence to the panels, which are lined with either tinfoil or copper strips, these last being electric conductors. So it will be observed that any attempt to tamper with the safe immediately sounds an alarm at the central station before even the safe has been reached.

3. Warehouses.

In warehouses the walls are arranged with the foil or copper strips or copper wire as the case may require, which are covered with paper to match the rest of the premises. The windows are arranged with springs to prevent their being raised without sounding the alarm, and wherever it is required a light wooden screen is inserted in the window at night, and this screen is connected by a system of springs to the general circuit, and cannot be cut through or removed without giving the alarm.

4. Residences.

There are many systems of electric burglar alarms used in the protection of private residences, most, if not all, of which the inventor is familar with.

In all exchange systems where more than one subscriber is on a circuit, there is absolutely no protection afforded to any of them, for the reason that the circuit may be cut at any point, and the place cannot be located, from the fact that there is no current on the line at all; and furthermore, an indefinite amount of resistance may be put in at any point, the indication of which upon the galvanometer in the central station depended upon for the location of the trouble will confuse the operator in charge, and give him absolutely no correct indication of the locality of the fault.

It has proved feasible to maintain several stations on one wire for fire alarm purposes, but in the United States burglar alarm systems of this kind have been entirely discarded for the individual line exchange system, as the only plan guaranteeing complete protection against burglars.

The plan of conducting the burglar alarm business is as follows:—An office is located in some convenient centre, from which wires are carried to the various structures to be protected. At the central station a man is constantly on watch, while a force of extra or special men are quartered in an adjoining room, or within easy calling distance of the watchman. Immediately on receiving an alarm from any of the protected premises, which are indicated by an annunciator in the usual way, the staff of specials is aroused, and at once securing the services of the police, they proceed to the point from which the alarm emanates, and are in readiness to pounce upon the burglar and surprise him when he leaves the premises.

The inventor, Mr. M. H. Kerner, has been nearly 30 years in the telegraph business in America, and for the past eight years has devoted his entire time and talents to the improvement of protective systems of burglar alarms. He first took hold of an old and at the time a crude system, and by the introduction of essential improvements made a marked success of it. But still there remained many objections and imperfections to be remedied in order to ensure absolute certainty of action in time of its use, and he devoted himself to the construction of an entirely new apparatus, utterly devoid of the faults contained in the first, and he has now secured what is said to be the most perfect system of burglar alarms devised up to the present moment.

As regards the general working of the system, on the first of each week a report is sent, sealed, to the subscriber, showing the time that his store, safe, or warehouse (as the case may be) was closed, and the exact time that it was opened each day. Should the employé return for any cause whatever, that time is also noted by signal and the name of the employé recorded, as indeed are any irregular openings for whatever cause noted, and a full report of the entire week's doings sent to the employer (subscriber). In all irregular openings a special report is sent to the subscriber next morning.

There are usually two men in the central office on duty, one ready to immediately go to the place of alarm, and the other to rouse the men asleep or resting. The first one secures the assistance of the police, and the other men follow on to the place where the signal came from.

In the central office there is a watchman's clock, to "check" the man on duty there; and it is a part of his duty to record the standing of the galvanometer needles connected to the instruments every fifteen minutes during the entire night. He examines the instruments and makes a record of the standing of the needles, so that any variation in the current of electricity, whether atmospheric or otherwise, is noted on the record, and steps are at once taken to remedy it.

In the inside of a warehouse traps are frequently connected with the counters and shelves, and sometimes with inside doors, so that in case a burglar secretes himself within a building during the day, he can hardly tamper with any wires without the alarm being sounded.

A system of springs is placed on the counters and shelves, and the goods are placed on these springs, so that the moment they are shifted the alarm is sounded.

For people who require a place of great security, for such valuables as diamonds, jewels, gloves, ostrich feathers, furs, laces, &c., it is not unusual to build cabinets of pine wood, and these are protected by springs, &c.

Arrangement of Signals.

An arrangement is made with the subscriber as to the proper time for his warehouse or safe, or both (as the case may be), to be opened in the morning, and a system of signals is arranged so that the central office may know that a person in authority has opened the same. But these signals are not accepted at an hour earlier to that arranged for between the central office and the subscriber, and, therefore, should the employé who carries the keys be overpowered on his way to business by burglars and the keys taken from him, and the burglars enter the place even after the usual hour of opening, unless the central office receives a correct signal a force is at once sent down to ascertain the reason.

The signals may be changed as often as desirable, and like the combination lock of a safe, they are unknown to any except those immediately interested.

Usually there are more persons than one who have to do with the signalling, but as each individual has a different signal it is easily known who signals. No one is allowed to know another's signals.

It is customary when an employé is discharged to change all the signals, so as to guard against the dismissed employé knowing the other signals.

In order to circumvent the designs and ingenuity of burglars, many devices and precautions are taken and every protection desired can be afforded by this system.

One of the advantages of this "Kerner" system over others is, that the central office has control of the circuit or line by day as well as by night, so that should the line be disturbed, cut, or crossed, the central office is immediately alarmed, and the line is repaired before the subscriber closes his place

By the old system it frequently happened that a subscriber could not communicate with the central office, because the line having been cut or crossed in some place the defect would only be discovered after the store was closed by notification from the subscriber per messenger.

Kerner's system controls the entire system during the day as well as the night with the system of the open attachments, therefore if a defect occurs anywhere in the central circuit the central office is notified by signal and a man is at once sent to locate and remedy the trouble during the day. By the old system the defect could not be remedied till next day, and this would necessitate a watchman being kept on the premises all night.

By the Kerner system, no matter at what portion of the building an entrance is effected, the alarm sounds and immediate action is taken. Whereas, where there is simply a watchman over the building he can only guard that portion immediately under his view, and thus while he was protecting and watching on the north or west side an entrance could be effected by the burglar at the south or east side of the building.

The general principle of the apparatus will be understood by reference to fig. 1. The portion of the apparatus shown to the left of the "line wire" represents the instruments placed at the central station. M, M^1, are two electro-magnets, of which M is wound to a lower resistance than M^1, so that it requires a proportionately stronger current to actuate it. The battery, B, under ordinary conditions, sends out a permanent current to line; this current flows through the bell, B^1, thence through the line, L, L, 7, the resistance, R, the wire, 8, to terminal, 9, of the switch, S^1. Under ordinary circumstances, that is to say, when every portion of the building fitted with the apparatus requires to be protected, the bars of the switch are turned over to the *right*, under these conditions the current flowing from line 8 passes through switch-bar, S^2, to wire 10, thence to wire 11, wire 12, wire 13, to terminal 14, from the latter the circuit is completed through switch-bar, S^3, to earth.

Now the resistance, R, is so adjusted that the current flowing through the magnets, M, M^1, is of such a strength as to cause the armature of magnet, M^1, to be attracted only, that of magnet, M, remaining unaffected. Under these conditions the circuit of the local battery, *e*, through the electro-magnet, *a*, of the drop indicator, A, remains open since the two armature levers are both away from their respective contact stops. If now by any cause the circuit of the line wire is broken, the armature of electro-magnet, M^1, falls back against its contact stop, and by closing the

circuit causes the indicator, A, to give a signal. Again, if the line wire should become put to earth the current passing through the electro-magnets will be increased, and the armature of M, being attracted against its contact stop, will close the local circuit and cause the drop of indicator, A, to fall. We thus see that either a disconnection or

protected; any attempt to break through the latter will either cause the circuit to be broken or the wires to be put in contact, and thus to cause an alarm to be given.

As it is required that the windows or doors can be opened during the daytime without sending an alarm signal, the switch, S, is provided. When the bars of this switch are

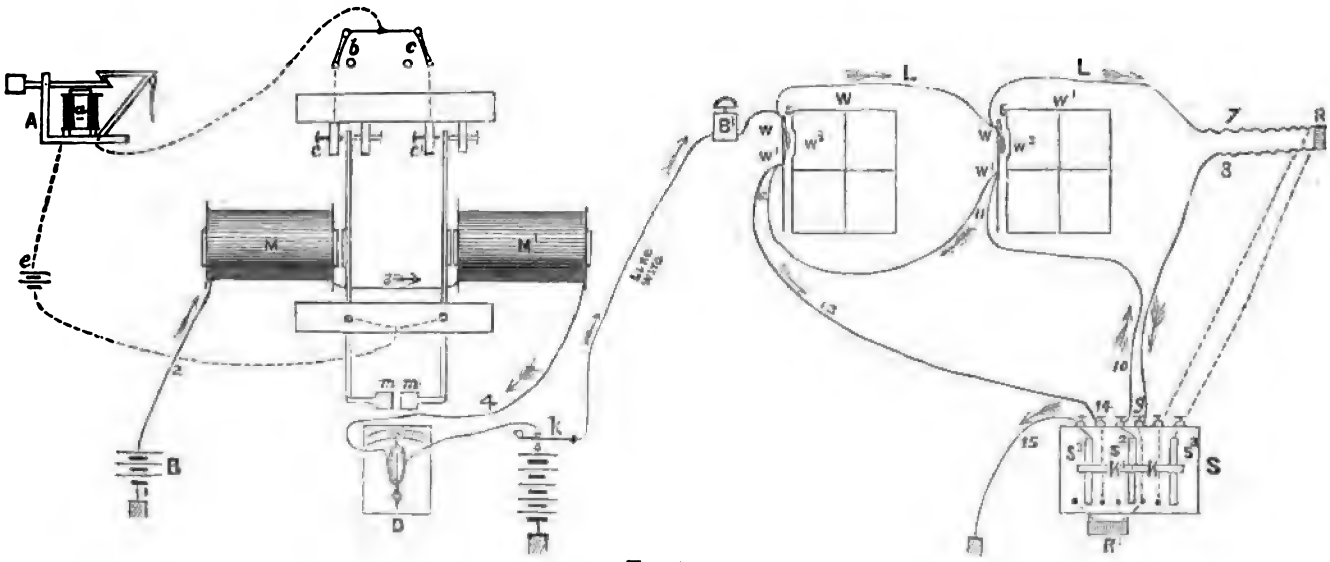


Fig. 1.

an earth will cause a signal to be produced at the central station.

W, W^1, represent two windows or doors which it is desired should give an alarm on being opened. Connected to W, W^1, are contact springs, *w*, *w*^{1}, which become pressed together when the windows or doors are opened. The effect

moved over to the *left*, then it will be seen that the right-hand switch-bar, S^1, short-circuits the resistance, R, whilst the circuit is completed to earth through the resistance, R$_1$, and switch-bar, S^3, there being no circuit by means of the spring-contacts of the windows, W, W^1.

The resistance, R$_1$, is of a different value to R, hence the

Fig. 2.

of this movement of the springs is, it will be seen from the figure, to put the line wire direct to earth through wire 13, terminal 14, switch-bar S^3, and wire 15. Wires 7 and 8, which are shown in the figure as connected to the resistance, R, form part of the circuit of the networks of wires or layers of tinfoil, sheet copper, &c., which are woven into or placed over the doors, panels, &c., which are required to be

strength of current flowing through the line when the switch-bars are over to the left will be different to that flowing when the bars are over to the right. As these current strengths will be indicated on the galvanometer, D, it is evident that the central station can tell the position of the switch, and, consequently, whether the windows are in connection with the alarm system or not.

According to arrangement it is understood that when the day's work is over at the warehouse, bank, &c., which is protected by the system, the switch is to be turned over to the position which protects the windows and doors, and, as explained, by means of the galvanometer deflection the central station can see that this has been done. When the station attendant perceives that the switch has been turned he depresses a key, *k*, which sends a strong current to line and rings the bell, B[1], thus the movement of the switch is acknowledged and the bank or warehouse knows that everything is in proper working order.

By means of the switches, *b*, *c*, the circuit of the drop indicator, *a*, with either of the armature levers, can be broken if required, so as to stop the ringing of the bell, which may be placed in circuit with the indicator, A. By having two switches it can be seen whether the signal is being given by the line making earth, or from being disconnected.

Fig. 2 shows the actual arrangement of the electro-magnets, M, M[1], the galvanometer, D, &c.

THE INTERNATIONAL ELECTRICAL CONFERENCES.

The delegates attending the conference, relative to the protection of submarine cables, now being held in Paris, assembled on Monday last (after visiting the various ambassadors) at the Bureau des Affaires Etrangères, in the grand reception room, just before vacated by the assembly which met to discuss the "Electrical Units" question.

It is somewhat unfortunate that several of the delegates belong to both conferences, as it appears probable that the progress of the negotiations will be thereby somewhat delayed.

The delegates were received at 3 p.m., and M. Duclerc, the Minister of Foreign Affairs, delivered a speech in which he welcomed them to Paris, at the same time descanting on the importance of the subjects about to be discussed, &c. M. Kern, the Swiss Minister, senior in rank amongst the delegates, replied in a short, complimentary speech, and after thanking M. Duclerc, suggested that M. Cochéry should preside at the meetings. The former gentleman then retired, and M. Cochéry took the chair. In a short oration he pointed out that both conferences could not well assemble on the same days, and the meeting was adjourned till the Wednesday at 2 p.m. The following programme is that sketched out by the French authorities :—

International Conference Concerning the Protection of Submarine Cables.

1st. Protection of Submarine Cables, comprising :—

A. Causes of destruction.
B. Cases in which the destruction is a punishable offence. Cases to which extenuating circumstances may be applied. Cases giving right of indemnity to the owners of ships who shall have, in extreme cases, sacrificed an anchor or a chain in order not to injure a cable.
C. Appointment of officers or agents, who shall have the right to estimate injuries.
D. Designation of competent courts.
E. Penalties.
F. Means of execution.

2nd. Protection of Ships engaged in the laying down and maintenance of Cables, comprising :—

A. Scheme for preventing collisions.
B. Examination of the privileges which it would be possible to allow in favour of ships intended to lay down cables.
C. Conditions necessary to make sure of the protection of the buoys intended to indicate the position of the cables in case of derangement or rupture.
D. Sanction which it is expedient to give to these various schemes.

3rd. Conditions of existence of Cables over each other, comprising :—

A. Examination of the rights of the first occupant.
B. Fixing conditions under which a second cable may be submerged over a first.
C. Rules to be observed in repairing juxtaposed and superposed cables.

List of Powers represented at this Conference.

Governments.	Names of Delegates.
Allemagne ……	M. le Dr. Dambach, Conseiller intime supérieur des Postes.
	M. Donner, Capitaine de vaisseau en non-activité, Conseiller impérial de Gouvernement.
Autriche-Hongrie	M. le Colonel de Bonn, Attaché militaire à l'Ambassade d'Autriche-Hongrie à Paris.
République Argentine ………	M. le Colonel Mansilla.
Belgique…………	M. Léopold Orban, Ministre Plénipotentiaire, Directeur des Affaires Politiques au Ministère des Affaires Etrangères de Belgique.
	M. Michel, Inspecteur-Général de la Marine.
Brésil ……………	M. le Vicomte de Nioac, ancien Officier de Marine.
Colombie ………	M. le Dr. Triana, Consul-Général de Colombie à Paris.
Chine ……………	
Costa-Rica………	M. Somzée, Premier Secrétaire de la Légation de Costa-Rica à Paris.
Danemark ………	M. le Comte de Knuth, Secrétaire de la Légation de Danemark à Paris.
	M. Wandel, Capitaine de frégate.
République Dominicaine ……	M. le Baron d'Almeda, Ministre de la République Dominicaine à Paris.
Espagne…………	Don Juan Ravina y Castro, Don Lucas Mariano de Tornos y Matamoros, Directeurs de Section de 1ère Classe du Corps des Télégraphes.
Etats-Unis ……	M. Morton, Ministre des Etats-Unis à Paris.
	M. Vignaud, Secrétaire de la Légation.
France …………	S. E. M. Cochéry, Ministre des Postes et des Télégraphes, assisté de MM.:
	M. J. B. Dumas, Secrétaire Perpétuel de l'Académie des Sciences, Membre de l'Académie Française.
	M. Clavery, Ministre Plénipotentiaire, Directeur des Affaires Commerciales et Consulaires au Ministère des Affaires Etrangères.
	M. Bergon, Directeur du Matériel et de la Construction au Ministère des Postes et des Télégraphes.
	M. Louis Renault, Professeur à la Faculté de Droit de Paris.
	M. Dupont, Capitaine de frégate.
Grande-Bretagne	M. C. Kennedy, C.B., Directeur du Service Commercial au Foreign Office.
	M. C. H. B. Patey, 3e Secrétaire.
	M. C. Trevor, Secrétaire-adjoint au Board of Trade.
	M. H. Farnall, Attaché au Foreign Office, remplira les fonctions de Secrétaire de la Délégation Anglaise.
Indes Britanniques ………	M. le Lieutenant - Colonel J. W. Bateman Champain, R.E., Directeur-en-chef du Départment du Télégraphe Indo-Européen.
Grèce ……………	M. le Prince Mavrocordato, Ministre de Grèce à Paris.
	M. Timoléon Argyropoulo, Professeur de Physique à l'Ecole Militaire d'Athènes.
Guatémala ………	M. Crisanto Medina, Ministre du Guatémala à Paris.
Italie ……………	M. Avarna di Gualtieri, Secrétaire de l'Ambassade d'Italie à Paris.
	M. Fedele Salvatori, Inspecteur-Général des Télégraphes.
Japon ……………	M. F. Marshall, Conseiller de la Légation du Japon à Paris.
Mexique…………	M. Velasco, Ministre du Mexique à Paris.
	M. F. Diaz Covarrubias, Ingénieur-Geographe.
Nicaragua………	M. Baille, répétiteur à l'Ecole Polytechnique.
Norvège…………	M. Nielsen, Directeur-Général des Télégraphes Norvégiens.
Perse ……………	
Pays-Bas ………	M. Jansen, Capitaine de vaisseau en retraite, Membre du Conseil d'Etat des Pays-Bas.
	M. Asser, Professeur à l'Université d'Amsterdam, jurisconsulte du Département des Affairs Etrangères des Pays-Bas.
Portugal…………	M. d'Azevedo, Chargé d'Affaires du Portugal à Paris.
	M. Robert Edouard Silva, répétiteur à l'Ecole centrale des Arts et Manufactures de Paris.
Roumanie ………	M. Phérékyde, Ministre de Roumanie à Paris.
	M. C. F. Robesco, Directeur-Général des Postes et Télégraphes.
	M. Emmanuel Bacaloglou, Professeur de Physique à la Faculté des Sciences de Bucarest.
Russie……………	M. le Vice-Amiral Likhatcheff.
	M. le Conseiller de Collège Rusi.
Salvador…………	M. Torrès Caïcedo, Ministre du Salvador à Paris.
	M. Raynaud, Ingénieur des Télégraphes.
Serbie ……………	M. Marinovitch, Ministre de Serbie à Paris.
Suède……………	M. Nyström, Chef de division à la Direction royale des Télégraphes.

Governments.	Names of Delegates.
Suisse	M. Kern, Ministre de la Suisse à Paris.
Turquie	Lacoine-Effendi, Directeur du Bureau technique de l'Administration des Télégraphes.
	Missak-Effendi, 1er Secrétaire de l'Ambassade.
Uruguay	M. le Colonel Diaz, Chargé d'Affaires de l'Uruguay à Paris.
Bureau international de Berne	M. Curchod, Directeur du Bureau.

M. Lavollée, Consul-Général de France.
M. Eschbaecher, Chef de Bureau au Ministère des Postes et des Télégraphes.
} *Secrétaires de la Conférence.*

[For list of delegates attending the Conference on Electrical Units, see our "Notes" columns.]

COMPETITION IN TELEGRAPHY.

An article in the *Philadelphia Record* states that Mr. Gould offered 1,500,000 dols. for fifty-one shares out of the one hundred shares of stock of a prominent New York daily, but without success.

The associated press pays the Western Union Telegraph Company 600,000 dols. This fact may give some idea of the magnitude of the business which Mr. Gould is seeking to control. There is another announcement made at the same time, which shows that the business of telegraphing is not to remain in its present monopolastic condition. Heretofore all attempts to found new telegraph companies on a large scale have resulted in disappointment to the public, though usually with profit to the promoters. The opposition was formerly made by Mr. Gould, who then found consolidation with the Western Union and control of the latter to be the plan affording him most gain. Hence the great hopes of the public from the building of the Mutual Union lines speedily became abortive. There is, however, not so much cause for alarm in the circumstances of the present telegraphic situation as many persons suppose. There is also one feature of the case to be stated, which may put a different and not wholly unwarranted face on the effort of Mr. Gould to control the associated press reports. A new rival is going into the business of building telegraphs, and Mr. Gould, whatever other use he may have, evidently desires to control the 600,000 dols. of business, "a growing business too," which the associated press has to give out. Say that Mr. Gould is too sensible to ruin the character of an association which he might control, or say that he could make more by ruining it. Either way, as a financier, his object his money, and there is no moral principle worth a straw in Wall Street involved. But say that the associated press is intended to be continued, and that in its absence something similar would speedily be devised. In that case Mr. Gould must be aware that what he has done others may do, and at this moment a project is on foot, such as is thus described by the above-mentioned journal.

"Mr. John W. Garrett is forming a company to lay an Atlantic cable in opposition to Gould's lines. Mr. Garrett is worth between 10,000,000 and 15,000,000 dols. He is building telegraph lines in every part of the country in competition with the Western Union Telegraph Company, and he proposes that his communications with Europe shall not be regulated by Mr. Gould's whims. Robert Garrett is in Europe, working up the project. A landing on this side has been assured. Siemens, the great electrician of Berlin, is working in hearty accord with the Garretts and has given them to understand that he will take all the stock not otherwise parcelled out. He says that a cable, with all the modern improvements, can be laid for one-fourth of the cost of the lines now connecting the two continents. Mr. James Gordon Bennett, of the New York Herald, put his name down for half-a-million of the stock of the company, and promised to raise the amount to a million if necessary. Mr. Garrett has also subscribed half-a-million. Capitalists of Boston, New York, and Philadelphia also appear in the list, and opposite their names are figures from 100,000 dols. downwards. The stock thus subscribed for is to be placed in the hands of trustees for a period of three years. The telegraph charges at no time are to exceed sixpence, or twelve cents, a word. This bold undertaking will probably provoke a lively war."

The first point in the war would naturally be to secure the control of a large and profitable portion of the telegraph business, and Mr. Gould would not display his wonted sagacity if he did not seek to control the dispensing of the associated press patronage. Successful men in these days do not trust to kind dispositions, but try to make themselves mathematically certain at every point. It will of course be a good thing for the public if Mr. Garrett and his colleagues will duplicate all Mr. Gould's lines, while Messrs. Gould and Pender will extend a manifold telegraph girdle around the world. Competition is the remedy for monopoly, and there can be no monopoly of such a useful and necessary, and now universal business, provided no exclusive franchises are granted.

[We are indebted to the *Galveston Daily News* for the above facts.]

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

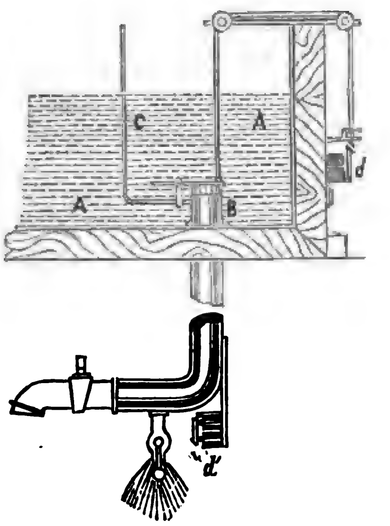
THE PROTECTION OF WATER PIPES.

To the Editors of The Electrical Review.

Gentlemen,—I enclose a tracing of an useful little invention recently patented by my friends Drs. Buxton and Ross, and as the cold weather will shortly be here, it may interest some of your readers to know that so simple a means for preventing the bursting of water pipes from frost may be had for so small a sum. I do not know if the drawing will make all clear, but nevertheless send a short sketch.

A represents an ordinary house cistern, showing the service pipe with the tap at end; into this is screwed or driven the small ventilating valve, B. It will be seen that air is admitted to the underside of the valve by the small pipe, C, so that when the valve is closed the pipe can be emptied, air being admitted through the pipe for such purpose. During the summer months the valve is raised by means of the cord shown, which can be attached to a nail or hook, and when frost is expected the cord is unfastened and the valve falling upon its seat, the pipe can be emptied by simply turning on the tap. So far perhaps this invention may not be of any *special* interest to you. To avoid forgetfulness on the part of servants, I have added the little electrical arrangement

shown, which is governed by a thermometer, and so long as the temperature is above 33° the valve does not act, but should it fall to that point an electric current passes, releasing the catches, *d*, *d*¹, which are so arranged as to cut out the battery and open the pipe at the lowest point of the house



service. A model of this for simply closing the valve electrically was exhibited for months at the late electrical exhibition at the Crystal Palace and excited some attention. The valves are sold at from 2s. 6d. each; any one can fit them. The electrical arrangement varies in its cost according to circumstances. I shall be happy to supply any information that may be required, and the valves can be obtained from me.

Yours truly,
FRANCIS M. ROGERS.

21, Finsbury Pavement.
October 12*th*, 1882.

THE GRISCOM ELECTRO-MOTOR.

To the Editors of The Electrical Review.

Dear Sirs,—In the Electrical Review of September 23rd an able writer, who discusses my double induction motor, quotes and combats a theory which he attributes to me. This theory is one of the many advanced in explanation of the motor by various European periodicals, but of which I plead entire innocence; in fact, I have purposely abstained from offering an explanation of the phenomenon which, for want of a better name, I have called "double induction." This phenomenon is described by the famous Mr. Hospitalier as follows:—

"The current of the electric source then only traverses the armature. Under these conditions if the current of the field magnet is open, the motor goes slowly enough, and even stops sometimes. By closing the circuit of the electro-magnet on itself, the speed of the motor is greatly increased, *the currents of induction developed in the wire which forms a closed circuit will then polarise the fixed magnet continuously, and maintain its magnetism with polarities, suitable to the direction of its rotation.*" *

Of course no one can suppose that a motor can produce more electricity than is supplied to it, and the writer does me an unconscious injustice in attributing such a fanciful theory to me. I even go further, and believe that induction, far from being an obstacle in motors, is the measure of their efficiency. If other views with regard to this latter proposition are held in England, I should be very glad to see them expounded.

Yours truly,
W. W. GRISCOM.

Philadelphia, *October 6th*, 1882.

The following is the original of Mr. Griscom's quotation from Mr. Hospitalier's description of the double induction motor [illegible] *ricien*, October 1st, 1881:—

"[illegible] la source électrique ne traverse alors que la [illegible]s conditions, si le circuit de l'armature fixe est ouvert, le moteur marche assez lentement et s'arrête même quelquefois. En fermant le circuit de l'armature fixe sur lui-même, la vitesse du moteur est grandement accrue, les courants d'induction développés dans le fil qui forme un circuit fermé polarisent alors l'armature fixe d'une façon continue et maintiennent son magnétisme avec les polarités qui conviennent au sens de la rotation."

[We are sorry that we inadvertently credited Mr. Griscom with the ideas put forward in the advertisements of the Electro-dynamic Company of Philadelphia, and we have pleasure in publishing his explanations. Perhaps our correspondent may now have seen our second article on this subject.—Eds. Elec. Rev.]

* The italics are mine.

THE ELECTRIC LIGHT AT CHESTERFIELD.

To the Editors of The Electrical Review.

Gentlemen,—As the Brush system of lighting has hitherto been regarded as one of the most efficient of the many systems before the public, the letter which Alderman Gee has addressed to the *Standard*, and which you republished last week, in reference to the electric lighting of Chesterfield, must have been read with some amount of surprise. It has certainly astonished not a few people in Chesterfield.

This town, which claims the honour of being the first to have the whole of its streets lit with electricity, was formerly illuminated with 200 gas lamps; and the lighting, which Alderman Gee characterises as a decided failure, is now done by means of 22 Brush arc lamps, of nominally 2,000 candle-power each, and 100 incandescence lamps of the Lane-Fox pattern, each supposed to give a 15 candle-power light. The town, it should be stated, is very irregularly built, and the Lane-Fox are used in the narrower streets and "passages," of which latter there are a number in the town. The arc lamps, Alderman Gee says, "are doing good service in some of the large streets," and it may naturally be presumed that he does not intend the word "failure" to apply to these. The incandescence lamps do vary in the amount of light, but the Mayor at a meeting of the Council last week, referring to them, said—

"Some possessed an illuminating power which really surprised him, the amount of light they gave being equal to 15 or 16 candle-power; whilst other lamps were as low as five or six candle-power. That was the cause of very great disappointment. . . . It was quite evident that the lighting of the town by the electric light had not succeeded to their expectation or to the expectation of the contractors, and yet they could hardly wonder. They must remember that Chesterfield was the first town lighted by electricity, and that a great deal of the work was necessarily tentative. The contractors had had to feel their way again and again. Incandescent lamps had never been employed for street lighting previous to their being used at Chesterfield. His impression was, considering the infancy of the electric lighting, that the company had done wonders."

Alderman Gee, at the same meeting, stated that the reason of this difference was that the contractor had not been able to get the proper lamps down from the Lane-Fox department. Some new Lane-Fox lamps, more nearly resembling the Swan in shape, are however now being put up in the town, and are giving the greatest satisfaction. As to the tradesmen of Chesterfield not adopting the arc light, it should be observed that there are not half-a-dozen shops in the town where more than thirty gas burners are used, and it is, therefore, absurd to suppose that arc lights of 2,000, or even 1,000 candle-power, could be profitably introduced into such comparatively small establishments. I enclose my card.

And remain,
ONE WHO DOES NOT BELIEVE THE ELECTRIC LIGHT HAS BEEN A FAILURE.

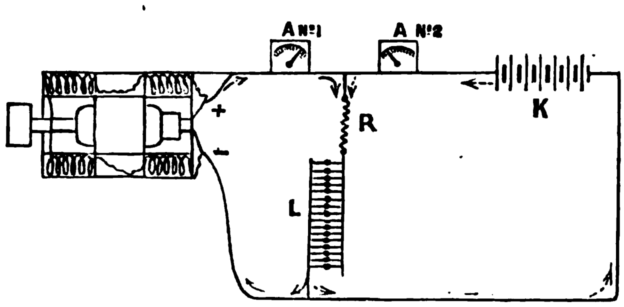
STORAGE OR SECONDARY BATTERIES.

To the Editors of The Electrical Review.

Dear Sirs,—Having lately gone on M. de Kabath's behalf to conduct an installation of his accumulators at M. Jaspar's, at Liege, I was led to make an experiment in order to demonstrate the efficacy of accumulators as a regulator for an unsteady supply of primary current.

Below is a sketch of the various connections and general arrangement; the direction of the am-meter pointers, A, indicating the direction of the current passing through them; the arrows indicate direction of machine current, and the dotted arrows the direction of secondary current, or that of the accumulators.

The field magnets of machine (Gramme type d'Atelier) were wound with fine wire, having a high resistance, and were connected up in a shunt, as shown. Two am-meters were placed in circuit (as shown), and the derivation for



lamp circuit was taken midway between these two, a suitable resistance being interposed in this derived circuit, as shown at R. I commenced by charging direct the 35 Kabâth accumulators, K, for about one quarter hour; this was done so as to have a reserve force to draw from. The lamp circuit of derivation of 16 Maxim lamps, L, was then connected, and sufficient current went by this derivation to maintain the lights at their normal capacity. The speed of machine was about 1,100 revolutions per minute, and at that time both am-meter pointers, having a right-hand deflection, indicated that the current of machine was sufficiently powerful to maintain the lamp circuit, and at same time to charge the accumulators.

On slowing down the speed of machine, the pointer of am-meter No. 2 assumed a left-handed deflection, as shown in sketch, and it was, therefore, evident that the accumulators were now discharging through lamp circuit, and thus helping the machine current. It will thus be seen that at the point of "take off" for the lamp circuit, there were two opposing forces which were diverted into one common force through the lamp circuit, and afterwards divided to satisfy their respective equilibrium. We now commenced changing the speed of machine by rapid and jerky motions, such variations exceeding 50 per cent. of the normal speed; not even a flicker, however, was noticeable in the lamps, which all along gave a perfectly steady light. The machine was then slowed down, so that the pointer of No. 1 am-meter was at zero, thus showing that the opposing electromotive force was such as to prevent the machine from generating any current. If the machine had been slowed down below this point, I anticipate that the accumulators would have discharged through the armature of machine and possibly burnt it, so consequently I looked upon this as the minimum speed. The charging circuit was now broken, and the lamps continued to burn without any alteration, being now fed by the accumulators alone.

There may be nothing new in this arrangement of accumulators, but I was certainly surprised to see the effective manner in which they kept the current perfectly constant, under such trying and great variations of speed.

It will also be seen that in a disposition like this, one must take into consideration the force of an opposing electromotive force, the same as if it were resistance, but it is difficult to make a simile between the two. For instance, at the point of lamp circuit derivation, the charging current meets an opposing electromotive force, which stops it dead and turns it off into another path; now, if instead of such opposing electromotive force, we had a resistance, no matter how high, there would still be a part of the charging current that would go through that resistance.

It therefore seems to me that interesting experiments could be made to determine exactly the nature and value of opposing electromotive forces, and rules should be laid down which would permit of their being taken into consideration in the same way as resistance. The charging of accumulators and the augmentation of their electromotive force during the charging, will no doubt afford a ready scope for such experiments.

I remain, Gentlemen,
Yours respectfully,
CHARLES W. FARQUHAR.

25, Avenue de l'Opéra, Paris.
October 17th, 1882.

Ways of Doing Business: England *v.* America.—The letter addressed to us by the representative of the Holborn Lamp Works, under the above heading, does not appear to us quite suitable to our correspondence columns, and as the matter of complaint may be almost said to suggest its own remedy, we do not think it necessary to refer further to the subject.

LANCASHIRE AND CHESHIRE TELEPHONIC EXCHANGE COMPANY (LIMITED).

By a circular received from the courteous secretary of the above company, we are informed that, "having made arrangements with the Postmaster-General, through communication, by means of Trunk Lines, has now been established between this company's exchange in Manchester and their exchanges in the following towns:—Liverpool, Blackburn, Burnley, Preston, and Wigan, and the rates fixed for these connections are as under:—

Manchester and	Liverpool	... ...	£60 per annum
,,	Blackburn	... ...	45 ,,
,,	Burnley	... ...	40 ,,
,,	Preston	... ...	55 ,,
,,	Wigan	... ...	35 ,,

"The above rates are exclusive of the company's local exchange subscriptions, which are as follows:—

Manchester	... ...	£20 per annum
Liverpool	... ...	20 ,,
Blackburn	... ...	12 ,,
Burnley	... ...	12 ,,
Preston	... ...	12 ,,
Wigan	... ...	12 ,,

"Subscribers to the Trunk Lines must also be subscribers to the local exchanges in the towns in which their offices are situated, *i.e.*—supposing A in Manchester wishes to speak to the company's subscribers in Liverpool, he will have to pay the local rate of £20 in Manchester and the Trunk rate of £60, making a total rate of £80 per annum. For this sum he will be able to call up any of the Liverpool subscribers, and they will be able to reply, but the latter cannot originate the conversation unless they also pay the Trunk rate. Special terms, however, can be made with firms having houses in both towns, or having a house in one town and a sole agent in another."

The above proposed extension of the telephone exchange systems alluded to in the preceding circular is in one respect at least gratifying to note; but we cannot disguise from ourselves the fact that the prices asked are very considerable. It will be interesting to observe, by the next report of the company, issued what proportion of the local Exchange subscribers will have availed themselves of the privileges thus offered. It should be an easy matter, we think, to estimate the cost of the said trunk lines, and the rates which would render their probable use remunerative, and it seems equally easy to perceive that a half-hearted policy in meeting the wants of the public will only fail to achieve that great success which a really liberal management would secure, whilst at the same time securing to the company a firm and highly valuable position.

The distance between Liverpool and Manchester is about thirty miles, and there are, we believe, two circuits for the telephone exchange service between them, *i.e.*, four wires comprise the said trunk lines from the one town to the other. Now the postal authorities charge, we think, rentals for such circuits: in the case of over-house wires at the rate of £10

per mile per annum for each two wires, and for open country lines £8 per mile also for each two wires.

It will therefore be comparatively easy to note that the cost of connecting the two exchanges mentioned would be, so far as lines are concerned (and we take the highest figure for our calculation, namely, £10 per mile), about £600 per annum. To this expense would have to be added the cost of two clerks to operate the switches, at the highest calculation, say, £130 per year each; that would give a total of £860.

In fixing a tariff to be remunerative to the company two things must be borne in remembrance—first, the working capacity of the circuits, and second, that the more subscribers obtained, the more valuable the system becomes to all in communication with the said system.

Considering these two things, we feel that the company is not consulting its own interests in demanding such rates as those contained in their circular; indeed, we believe that telephone business generally, in this country, has been injured enormously by excessive charges; but it is not usually so easy to go into even approximate calculations as it is in the instance selected from the Lancashire Company's circular, owing to the difficulty of ascertaining the cost of the various installations, and the value of the assets of such concerns.

In the case we are considering a good opportunity presents itself for viewing by the light of the trunk lines extension rates the general policy of existing telephone companies.

The opportunity is good mainly because the wires are such as are erected by the Post-office authorities at a rental only, and therefore we can get within a trifle at the yearly cost of the wires to the company renting them.

It will be seen by the circular that two firms, one in Manchester and one in Liverpool, would have to pay together for the privilege of conversing by telephone with one another the sum of £120 per year *in addition* to their respective subscriptions to the local exchanges.

The cost to the company, as we have before mentioned, is about £860, as follows:—

Two circuits (four wires) of 30 miles each, at £10 per mile per year...	£600
Two additional clerks to work switches, say	260
	£860

Now it appears that the two towns mentioned have a total of subscribers to the two exchanges numbering 1,334. The question then arises, is it not probable that a more remunerative business could be done by encouraging, by means of a lower tariff, a greater proportion of that number to avail themselves of the means of intercommunication than is likely to do so while the tariff is £60 *additional* per subscriber.

If fourteen subscribers pay each £60 the expense is covered, but what would happen if one hundred paid £15 each? We fancy the value would be increased considerably to each subscriber, because he could converse with so many more than is likely with the higher rate, and this fact again would probably induce other firms to join the local exchanges who before had held aloof, whilst at the same time a handsome addition would be obtained to the net revenue of the company.

One hundred subscriptions of £15 each (in addition to local exchange charges)	£1,500
Deduct 10 per cent. on gross receipts for G.P.O. licence...	150
	£1,350
Expenses of circuits and operators as before stated ...	860
Leaving a balance of	£490

or about 22½ per cent. profit on the amount actually expended for the working of the said trunk lines. There is to be deducted, however, from this percentage, a small proportion for office expenses, &c.

The policy of catering for the few at high rates, rather than for the many at low ones, cannot be more unfortunately applied than in the case of telephonic exchanges, and yet the former is the policy which has, strangely enough, always obtained in this country. Will not the rates quoted in the circular printed at the head of this article prove once practice the triteness of the old saying about the enny or the slow shilling?

NOTES.

Perpetual Motion. — After describing the electric launch recently run on the Thames, the *Spectator* of Sept. 30th says:—"Nothing is said about expense, but a boat which can travel at this speed without coal, and with no funnel, must for many purposes be of almost immediate use. *As the charging machines can be put up anywhere, the practical problem of electricians must be to reduce the size and weight of the accumulators. Once small enough to be carried, they might drive a steamer across the Atlantic, being perpetually recharged by a dynamo driven by the motion itself.*"

The Steam-ship "Silvertown."—The India-rubber, Gutta-percha, and Telegraph Works Company have received a telegram from San Francisco informing them of the safe arrival of their steamer *Silvertown* at that port on Sunday, the 15th inst. All well on board.

Lightning Conductors.—Messrs. Dixon, Corbitt, & Spence, manufacturers of Vyle's patent easily-tested lightning conductors, received the highest award (silver medal) for such exhibits at the Tynemouth Exhibition.

The Electric Light on board Ship.—The s.s. *Tararera* and *Waihora*, now building by Messrs. Denny Bros., of Dumbarton, for the Union Steam Ship Company of New Zealand (Limited) are to be lighted by the Edison Electric Light Company. Each steamer will be lit by about 150 A lamps of 16 actual candle-power, supplied by an Edison L Dynamo, driven direct by a Brotherhood engine.

The yacht *Namouna*, which belongs to Mr. James Gordon Bennett, of the *New York Herald*, is lighted throughout with the Edison system, comprising about 150 A lamps fed by an L dynamo, driven from a special engine by belting. Although exposed to some severe storms in her passage across the Atlantic to the coast of France, the light fully proved its reliability under stress of weather, nor was there any tendency of the belt to slip even when the sea was at its roughest.

This fact is important as proving that although engines driving direct may be preferred by some ship-builders, their fears in regard to slipping of the belt and consequent extinction of the light in a heavy sea, are more theoretical than practical.

Electric Lighting and the "Ferranti" Machine—The following letter, which appeared in the *Times* of Tuesday last, is of sufficient importance to reproduce in our columns:—

Mr. Charles Mossop, in addressing you under the above heading, has more than once made reference to the evidence I gave some months ago before a Parliamentary Committee regarding the cost of establishing the electric light in populous districts. He says:—"No doubt great strides have been made in three months, but it is difficult to understand that the figures then given—£100,000 per centre and a cost of £22,000 annually—have so nearly disappeared." Mr. Mossop has correctly quoted the figures I gave before the committee, only in a previous letter of the 28th ult. he made me attribute them to a district of one square mile area, whereas I distinctly stated that they were the estimated amounts appertaining to one-quarter of a square mile only of a densely-populated and well-to-do neighbourhood. They were based upon the results of actual and somewhat extensive experience, and on the assumption that the electric light was to take only a minor share in the total illumination, leaving still to gas all ordinary domestic uses. Nor do I know of any very recent discovery of a character likely to affect these figures.

It is true we have been told lately of a new dynamo machine to which iron in the rotating coil is dispensed with, and which is said to be capable of developing a light of 2,000 candles with an expenditure of three-fourths of an indicated horse-power. In testing these results by the dictates of science I find they exceed considerably the utmost limits that could possibly be attained with a dynamo-machine and lamp of ideal perfection, and must therefore be regarded as chimerical. But, although the new patent has not yet been specified, enough has transpired regarding its character to enable me to judge of its real capabilities. The inventor has been until recently employed at my works, and the machine with which he proposes to revolutionise the world is only a modification in minor details of the Siemens alternate current machine, which is largely used, and which completely embodies the much-vaunted quality of the absence of iron in the rotating coils.

Electric lighting appears to have entered a stage at which the public just possesses sufficient knowledge of the subject to make them follow any sanguine leader into the realms of speculation; and, so far from

regretting the want of readiness shown on the part of local authorities to favour the granting of licences and the procuring of provisional orders, I think that real progress would be very much retarded by the granting of such applications without reserve. The mechanical means at present at the disposal of many of the electric lighting companies are as yet entirely inadequate to grapple with the enormous production of valuable plant necessary for such applications on a comprehensive scale, and it would therefore be advisable that each grant should be made conditional on the work being effected within a limited time.

I am your obedient servant,

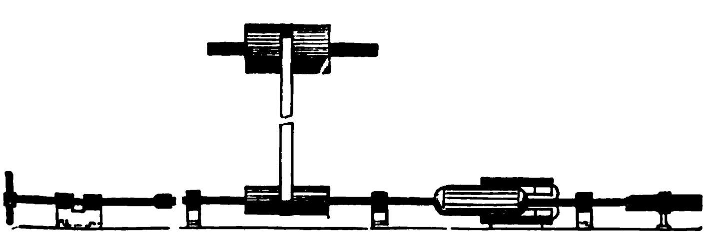
12, Queen Anne's Gate, S.W. C. W. Siemens.

The second portion of Dr. Siemens' letter appears to call for a few remarks. We agree with this eminent electrician in his criticism regarding the production of a light of 2,000 candles at an expenditure of three-fourths of an indicated horse-power, but beyond this we cannot go. We have not yet seen the "Ferranti" machine, neither has Dr. Siemens, we believe, but if the brief description of its construction which we received some weeks ago from one of the representatives of the Hammond Company was correct, we can safely say that the invention is something more than a "modification in minor details" of Dr. Siemens' aternating current machine.

Without taking the decided views on this subject which some of our contemporaries have thought fit to adopt, it may be well to recall the fact that sometimes the opinions of equally celebrated electricians—as well as lawyers—may differ. As an instance of this let us go back to the introduction of the Gramme machine model (by Werdermann) into England.

A few electricians encouraged him, while some high authorities unhesitatingly pronounced the invention a "mistake," and the ideas of the inventor "quite impossible of realisation." One indeed, scarcely inferior in ability, if at all, to Dr. Siemens himself, to whom Mr. Werdermann submitted the machine, declared it to be "mere nonsense." We are all aware of the great success achieved by the Gramme machine, and we all know that doctors disagree. Whilst advising our readers not to put too much faith in any extravagant assertions which may have been spread abroad concerning the efficiency of the new dynamo, we think that in the face of the instance given above, it is well to bear on the side of caution, and we shall reserve any definite opinion on the "Ferranti" machine until we have had the opportunity of seeing and examining it. Dr. Siemens ranks high as an authority on electrical matters, but we may assume that Sir William Thomson, who is also equally well known as an expert on such matters, is satisfied with the *bona fides* of the invention with which his name has been associated.

Dynamo-Electric Machine.—Patent No. 262,782. Filed in the United States of America Patent Office, February 25th, 1882, by John H. Irwin.



Claim.—1. In a dynamo-electric machine, the combination of an armature adapted and arranged to be drawn out of or pressed into the field-of-force-magnets and a commutator adapted and arranged to have movement across the face of its brushes, substantially as described.

2. In a dynamo-electric generator, the combination with the armature, of a screw connected therewith and adapted and arranged to control the position of the armature within the field of the exciting magnets, substantially as shown and described.

3. The combination, with the field-of-force magnets, of an armature, shaft, screw, bearing wheel, and commutator, the whole arranged to operate substantially as shown and described.

4. In a dynamo-electric machine, the combination of enclosing field-of-force magnets, an enclosed armature, and a commutator, the armature and commutator being adjustable back and forth by the same mechanical means, substantially as described.

5. In a dynamo-electric machine, the combination of the field-of-force magnets, an armature and a commutator, both adjustable back and forth, and the latter elongated, so as to be at all times subject to sufficient contact with the commutator-brushes, substantially as described.

6. In combination, in a dynamo-electric machine having enclosing field-of-force magnets and an enclosed armature, a shaft to which both the armature and the commutator are directly secured, provided with a clutch adapted to permit free revolution of the shaft while the same may be moved back and forth, substantially as described.

Electric Lighting.—The electric light was introduced to the Motherwell district on Friday week by Messrs. James Goodwin and Co., ironfounders. A lamp was placed on a pinnacle of the works in Park Street, and not only lighted the whole departments of the works, but shed a clear light in Park Street and Merray Street, and the surrounding neighbourhood. During the night large crowds of people assembled in the vicinity of the light. The Police Commissioners are negotiating for the introduction of the light for the town lighting.

At a special meeting held last week the Hamilton Town Council appointed a committee to report on the expediency of applying for a Provisional Order under the Electric Lighting Act.

Melbourne hitherto has been rather behind in adopting the electric system of lighting cities, the only result being in the erection of four lamps in the Eastern Market. Probably an effort of the Government to light the railway station at the Spencer Street Terminus may bring it into greater favour, as an offer has been made to erect lights by a public company gratuitously, as an experiment, and the Government has given its consent. Besides these signs of progress, a company has asked permission of the Government to drive a tunnel from a point on the Yarra at Dight's Falls, through a portion of Studley Park to a place a quarter of a mile lower down the river. This would give a fall from point to point of 27 ft., and, it is said, would supply sufficient force to generate electricity enough to supply the whole of Melbourne and the suburbs. The Government, in the meantime, will take the request into consideration. Melbourne is not particularly happy with its present supply of gas, and, unfortunately, must submit, as the competing gas companies were permitted to coalesce, and now have a monopoly in the lighting of the city.

The Forfar Town Council have agreed to delay in moving for a Provisional Order. The convener pointed out that the corporation could only oppose an application by any electric lighting company to Parliament for powers to light the town by electricity on the ground that it would be fatal to the interests of the town. The introduction of the electric light would be so in Forfar, for there was £1,000 of an annual burden in connection with the gas works of the town for all time coming.

A special meeting of the Glasgow Town Council was called for Thursday, to consider the propriety of applying to the Board of Trade this year for a Provisional Order under the Electric Lighting Act, 1872.

The Bradford Town Council, at a meeting on Tuesday, authorised the Town Clerk to take the necessary steps under the Electric Lighting Act to obtain powers for supplying electricity for public and private lighting purposes within the burgh.

A New Electric Light.—We have been much interested in examining a new candidate for public favour in the way of an incandescent electric light; we refer to the one manufactured by the Bernstein Electric Light Manufacturing Company, of 41, Arch Street, Boston. This light has some especial features, was patented in June, 1882 (English) application of 2nd June), and is based on entirely different principles from all the patented systems of incandescent lamps. It is unlike the Edison, Swan, and Maxim; where each of these use a very delicate carbon filament as a light giving body (and these filaments do not withstand the action of strong currents of electricity, but are easily destroyed, and economy in an incandescent system of lighting is obtained by an application of a strong current), in the Bernstein lamp, the light is given out by an unfusible and insulating material, which has been covered with a deposit of carbon, having the shape of a cylinder. This lamp, the Bernstein, gives a very brilliant light, which can be regulated or graduated just as appears desirable or necessary. Lamps of different powers are furnished as desired, and any kind of dynamo machine may be used to furnish the current.—*Boston Journal of Commerce*, September 30th.

Electric Illumination of the Instrument Hall of the Head Telegraph Office at Berlin.—This hall was formerly lighted up with 103 gas burners. With such a number of flames it is natural that, in spite of the numerous and efficient ventilators, the temperature became unpleasantly high, and that the air was seriously contaminated with the products of combustion. Hence it was resolved, in the course of last spring, to make experiments with Swan's incandescence lamps. A gas-engine kept a Siemens' alternating current machine (model W³) in motion, and this furnished the current needed for 18 Swan lamps, which were substituted for the same number of gas flames.

These lamps were in action from the approach of darkness to 9 p.m., giving out a mild, equable light, agreeable to the eye. As the heating power of these lamps is quite insignificant in comparison with that of the gas burners, and as the duration of the light fully answered expectation, the Post-office resolved to make arrangements for lighting the hall exclusively by means of electricity.

Two Heine's steam-boilers were erected on an adjacent plot of ground, furnishing steam for two dock engines, which work up to 15 horse-power. The necessary current will be produced by Siemens' dynamo machines.

An ultimate decision on the number of the lamps, &c., has not been arrived at, as the postal authorities purpose making experiments on the applicability of the arc light (Siemens' differential lamps). During the experiments with the Swan lamps an occasional extinction of some of the lamps had occurred, due generally to contact between the wires which were only temporarily secured. Although with permanent arrangements such contacts would not be apprehended, doubts arose concerning the great number of the incandescence lamps required, each of which would be a possible source of mishap, and it was feared that considerable trouble would be required for keeping the lamps in order and removing any disturbance.

A single arc light illumines a considerable space, and 10 to 12 such lights would suffice for the entire hall. The overlooking and management of so small a number of lights would be easier than that of 103 incandescence lamps. Hence for the present the twenty work tables on the side of the Jägerstrasse are to be lighted with the same number of incandescence lamps, whilst the rest of the space will be illuminated with differential lamps.—*Electrotech. Zeitschrift.*

Local Authorities and the Electric Light.—The Board of Works for the Wandsworth District agreed on Wednesday afternoon to the following recommendation of its General Purposes Committee :—"The Committee have considered the applications for the consent of the Board to Board of Trade licences or provisional orders being granted for the supply of electricity within the district, received from the following companies: The Metropolitan (Brush), the Gülcher, the Edison, and the West Middlesex, and Messrs. Ferranti, Thompson, and Ince ; and recommend that the Board do not grant their consent to any of the proposed schemes, and that the applicants and the Board of Trade be informed accordingly ; and that the Board of Trade be further informed that the Board have it in contemplation to apply for a licence themselves for the supply of electricity in the district when the system of electric light is more matured."

The Transmission of Articulate Speech and Singing by means of Telephones without Wires attached to them.—Mr. Frederick John Smith, of Taunton, has communicated to us the following note relating to his experiments on the above subject :—If a large coil of wire be made, from three to 10 ft. in diameter (these were the sizes tried), and placed in connection with a microphonic transmitter ; then if the transmitter be either spoken to, or sung to, the voice is perfectly reproduced in a telephone consisting of only a magnet and disc, held within the great coil. The telephone will give its sound when held at any angle within the coil, but its greatest sound is when the disc is in the same plane as the coil. The effect is augmented if two coils, hung about a foot apart, and two telephones, without bobbins, be used, the head being placed between them. Perhaps the best result is obtained by using two coils of the form used in Gaugain's galvanometer, placed with their vertices pointing to each ear ; two light discs and magnets are then attached to the ears by a spring ; thus the operator is quite unincumbered by any wires whatever. The Gaugain coils are put in circuit, with a microphonic transmitter and battery, in the same way as the large coil.

Experiments similar to those described by Mr. Smith were made some time ago by Mr. Willoughby Smith and referred to by him at one of the meetings of the Society of Telegraph Engineers and of Electricians during the present year. Perhaps our correspondent has not seen Mr. W. Smith's pamphlet on "Induction," in which these experiments are described.

Technical Education.—A class in electrical engineering, in connection with the City and Guilds of London, has again been formed at the Royal Institution, Hull, conducted by Mr. Thos. West, of the telegraph department, and is well attended by members of the telegraph staff in that town. The extension of these classes must ultimately benefit the department by improving the technical knowledge of the employés. In this respect they are far behind many continental countries, where a high scientific training is considered a necessity.

Legal.—The United Telephone Company v. Harrison, Cox-Walker, and Company.—This case came again before the court on Wednesday, the 18th, and was a motion to commit the defendants for not having complied with the order of Mr. Justice Fry, of the 19th of May last, for non-delivery of certain instruments which had, since that judgment, come into their possession. It having been proved (by affidavit) that the said instruments had not come into the defendants' possession, the motion was dismissed, the costs consequently having to be paid by the plaintiff company.

The North-East Coast Exhibition.—Messrs. Mechan and Sons, Cranston Hill, have been awarded a silver medal for their patent reply engine and steering telegraph, and a silver medal for their ships' lighthouses.

On the New Employment, in Therapeutic-Electricity, of Clay.—Académie de Médecine de Paris, meeting of the 10th October, 1882.—Doctor Apostoli presented to the Académie a memoir, of which these are the conclusions :—I advocate the introduction, into the practice of electro-therapeutics, of the use of a new electrode, clay, destined to replace, in many cases, the rigid electrodes almost solely employed up to this day. Clinically, it offers the following advantages :

1. It facilitates and completes certain galvano-caustic chemical applications, that is to say, positive or negative cauterisation applied to the treatment of ulcers and wounds of a bad nature. Better than any other electrode, it limits and terminates certainly all electrolytic action, cauterising all that wants cauterising, without exceeding the limits traced beforehand.

2. It makes sure of a greater constancy of current. A little more resistance, in fact, than ordinary plugs, it dries up less rapidly, and preserves longer the same degree of conductibility ; it moistens well the epidermis, and applies itself uniformly upon it.

3. It facilitates applications of long duration. It is sufficiently viscous, in fact, to adhere spontaneously to the skin, it avoids, thus, the necessity of an assistant.

4. It allows of varying at will, the extent, the form of the electrodes, and their application surface, and is calculated to familiarise the practice of galvanisation, for it is an electrode, soft, easy to obtain everywhere, which is not consumed, takes any desired form, moulds itself upon the skin, and covers a facultative extent of surface.

5. It allows of limiting, of localising the total action of the current by reducing to the minimum the bad influen[illegible] of its diffusion, or of its derivation. One can, in fact, c[illegible] the circuit upon itself by means of two conce[illegible] increase, thus, without danger the intensity of the cu[illegible] and render the operation more complete and more [illegible] Galvano-caustic chemical applications to the head, an[illegible] cure of aneurisms of the aorta, ought to derive great [illegible] from it.

6. It diminishes the pain of galvano-caustic c[illegible] applications. By rendering the skin more conductiv[illegible] to a more complete humectation, it diminishes the [illegible] to its passage, and, consequently, the calorific effec[illegible] current of which pain is the direct consequence.

International Conference for the Determination of Electrical Units.—List of Powers represented at the Conference.

Governments.	Names of Delegates.
Allemagne	M. le Dr. Werner Siemens, Conseiller intime de Gouvernement, Berlin.
	M. le Dr. Wiedemann, Conseiller de cour, Professeur à l'Université de Leipzig.
	M. le Dr. Helmholtz, Conseiller intime, Berlin.
	M. le Dr. Kohbrausch, Professeur, Wurtzbourg.
	M. Ludewig, Conseiller intime des Postes, Berlin.
Autriche	M. H. Militzer, Conseiller au Ministère du Commerce.
Hongrie	M. Isidore Tröhlich, Professeur à l'Université de Buda, Pesth.
République Argentine	M. le Colonel Mansilla.
Belgique	M. Banneux, Ingénieur en Chef des Télégraphes de l'Etat, M. Rousseau, Professeur à l'Université de Bruxelles et à l'Ecole Militaire, 1ère Commission.
	M. Evrard, Ingénieur des Télégraphes, de l'Etat; M. Gérard, sous Ingénieur des Télégraphes, Chargé de cours à l'Université de Liège; M. Pérard, Professeur à l'Université de Liège; Mr. Van Rysselberghe, Météorologiste à l'Observatoire de Bruxelles, 2e Commission.
	M. Van den Mensbrugghe, Professeur à l'Université de Gand, 3e Commission.
Chine	M. Macartney, M. Tching-Tchang, Secrétaries de la Légation de Chine à Paris.
Colombie	M. le Dr. Triana, Consul-General de Colombie à Paris.
Costa-Rica	M. Léon Somzée, Premier Secrétaire de la Légation.
Danemark	M. Lorenz, Professeur à l'Ecole Militaire de Copenhague, 1ère Commission.
	M. le Capitaine Hoffmayer, Directeur de l'Institut Météorologique, 2e Commission.
Espagne	M. Adolfo J. Montenegro, Inspecteur des Télégraphes.
	M. Justo Uruna y Velasco, Directeur de Section de 1ère Classe des Télégraphes.
Etats-Unis	M. Trowbridge, Professeur à l'Université d'Harvard.
	M. H. A. Rowland, Professeur à l'Université de John Hopkins.
	M. G. F. Barker, Professeur à l'Université de Pensylvanie.
France	Son Excellence M. Cochéry, Ministre des Postes et des Télégraphes.
	M. J. B. Dumas, Secrétaire perpétuel de l'Académie des Sciences, Membre de l'Académie Française.
	M. Jamin, Membre de l'Académie des Sciences, Professeur à la Faculté des Sciences de Paris.
	M. Clavery, Ministre Plénipotentiaire, Directeur des Affaires Commerciales et Consulaires au Ministère des Affaires Etrangères.
	M. Bergon, Directeur du Matériel et de la Construction au Ministère des Postes et des Télégraphes.
	M. Blavier, Directeur-ingénieur des Télégraphes, Directeur de l'Ecole supérieure de Télégraphie.
	M. Mascart, Professeur au Collège de France, Directeur du Bureau central météorologique.
Grande-Bretagne	Sir William Thomson, F.R.S., Professeur à l'Université de Glascow.
	M. Carey Foster, F.R.S., Professeur, Université Collège, Londres.
	Lord Rayleigh, F.R.S., Professeur à l'Université de Cambridge, Pair du Royaume.
	M. Fleeming Jenkin, F.R.S., Professeur à l'Université d'Edimbourg.
	M. le Dr. Hopkinson, F.R.S.
Grèce	M. le Ministre de Grèce à Paris.
	M. Protopappadaky.
	M. Timoléon Argyropoulo, Professeur de Physique à l'Ecole Militaire d'Athènes.
Guatémala	M. Crisanto Medina, Ministre du Guatémala à Paris.
Italie	M. le Chevalier Joseph Pisati, Professeur de Physique à l'Ecole d'Application de Rome pour les Ingénieurs et à l'Institut supérieur de Florence; M. le Chevalier Antoine Roiti, Professeur de Physique à l'Ecole d'Application de Rome pour les Ingénieurs et à l'Institut supérieur de Florence, 1ère et 3e Commissions.
	M. le Commandeur Jean Cantoni, Sénateur du Royaume, Professeur à l'Université de Pavie; M. le Commandeur Pierre Tacchini, Directeur du Bureau central de météorologie, 2e Commission.
	M. le Chevalier Galileo Ferraris, Professeur au Musée Industriel de Turin, pour les 3e Commissions.
Japon	M. Henri Becquerel, répétiteur à l'Ecole Polytechnique.
Luxembourg	M. Willière, Ingénieur, Directeur des Chemins de fer du Prince Henri.
Mexique	M. F. Diaz Covarrubias, Ingénieur-géographe.
Nicaragua	M. Baille, répétiteur à l'Ecole Polytechnique.
Norvège	M. Broch, Ancien Ministre, Professeur à l'Université de Christiania.
Pays-Bas	M. le Dr. G. Bosscha, Directeur de l'Ecole Polytechnique à Delft.
Portugal	M. d'Azevedo, Chargé d'Affaires à Paris.
	M. Edouard Robert Silva, répétiteur à l'Ecole centrale des Arts et Manufactures de Paris.
République Dominicaine	M. le Baron d'Almeda, Ministre de la République Dominicaine à Paris.
Roumanie	M. Phérékyde, Ministre de Roumanie à Paris.
	M. C. F. Robesco, Directeur-Général des Postes et Télégraphes de Roumanie.
	M. Emmanuel Bacaloglon, Professeur de Physique à la Faculté des Sciences de Bucarest.
Russie	M. le Conseiller Lentz, Professeur à l'Institut Technologique de St-Pétersbourg.
	M. l'Académicien Wild.
Salvador	M. le Ministre de Salvador à Paris.
	M. Jules Raynaud, Ingénieur des Télégraphes.
Suède	M. Nyström, Chef de Division à la Direction Royale des Télégraphes.
Suisse	M. Weber, Professeur au Polytechnicum de Zurich.

Tenders for Telegraph Construction.—Tenders are invited by the Government of the Orange Free State for the supply of material and the erection of the following telegraph lines in the Orange Free State, South Africa:—Between Winburg and the Vaalriver, *via* Ventersburg, Kroonstad and Heilbron; between Winburg and Ladybrand; between Senekal and Ficksburg, and between Wepener and Smithfield. No tender will be entertained unless for the whole of these lines. The probable aggregate mileage of the lines combined will be about 350 miles, more or less. The average number of poles required per mile will be about 18. The percentage of No. 8 (straining posts) will be about 6 per cent. Specifications are to be seen, and other information obtained, at the offices of the different Free State consuls, in England at London, in Germany at Berlin and Hamburg, in Holland at Arnhem, in Belgium at Brussels, in France at Paris, in America at Philadelphia, and at the office of the Government Secretary at Bloemfontein, Orange Free State.

Experiments in Telephony.—M. Van Rysselberghe has communicated the following interesting note to *L'Opinion*:—The Minister of Public Works having, a short time since, ordered some experiments of telephony on long distances to be made, a complete application of the system of M. Van Rysselberghe was made upon the lines of the Belgian telegraphic network. The trials took place on Saturday, the 7th October, and were crowned with complete success. At Brussels, at the Observatory, were stationed: M. Olin, Minister of Public Works; Mr. Fish, Resident Minister of the United States charged by his Government to inform them on the new method; M. De Large, Director of Telegraphs; M. Weissembruck, Secretary to the Minister of Public Works; M. Hooreman, doing duty for the director of the Observatory, and M. Van Rysselberghe. At North Brussels: M. Buels, head of the telegraph administration office. At Anvers: Inspector Banneux. At Ostend: Engineer Lambotte and M. Walraevens, assistant officer of the Observatory. From 2 to 4 o'clock, whilst the telegraphic work was at its maximum, these persons communicated with each other with the greatest ease by wires taken at random into the network of telegraphic lines, and whilst these wires continued to transmit telegrams by their ordinary service. Thus, for example, the wire connecting the Observatory of Brussels with its post at Ostend served simultaneously the service of the telemeteorograph, a Morse telegraph, and the telephonic correspondence. Then the wire (No. 2 in the nomenclature of the Belgian State lines, and devoted at present to the service of the Hughes' fast speed telegraph) transmitted duplex telegrams, that is to say, messages which

crossed each other in both directions, of which one set was directed towards Anvers, whilst the others went towards Brussels; and at the same time, by the same wire, conversation was carried on between M. Banneux and the Minister of Public Works.

The Minister expressed his opinion that the correspondence between the two towns was much better than the communications actually exchanged between two offices in the same town. In fact, the voice arrived clear, distinct and powerful. It is important to notice that this triple communication only required a single wire; there was no return wire. M. Olin sent to Mr. Fish, Minister of the United States, as a *souvenir* of the experiments at which he had been present, the ribbon bearing one of the ordinary telegrams received by a Morse instrument at the same moment that Mr. Fish was speaking to M. Banneux, by the same wire. This is the text of the telegram:—"The present Morse despatch is transmitted from Anvers to Brussels by the aid of a wire by which a telephonic conversation is simultaneously carried on by means of the apparatus and arrangements of M. Van Rysselberghe." Similar demonstrations will shortly take place in London.

On the Substitution of Hydrogen Peroxide for Nitric Acid in Galvanic Elements.—By Arthur König.—Landolt has recently proposed to substitute for the nitric acid used in Grove and Bunsen elements, the solution of hydrogen peroxide (otherwise known as hydroxyl or oxygenated water) in water, as it is now industrially prepared and offered for sale. By this change both the corrosive action upon the metallic portions of the battery and the irritation to the lungs of the experimentalist are done away with.

I have examined the electromotive power of such modified elements, which I shall distinguish as Grove-Landolts and Bunsen-Landolts, and have obtained the following results. The solution of hydrogen peroxide employed contained only 2·25 per cent. of the actual peroxide.

The measurement of the electromotive power was executed according to the compensation method proposed by and named after Prof. Du Bois-Reymond.

As a standard unity was employed a Daniell element, in which the zinc was immersed in a concentrated solution of sulphate of zinc, and similar elements were used for compensation.

A Grove element, with nitric acid of specific gravity 1·33, and dilute sulphuric acid containing ten per cent. H_2SO_4, gave immediately, when put together, an electromotive power of 1·74 Dan. After the element had remained open for 20 minutes it fell to 1·72, and after being closed for 50 minutes, without further resistance, to 1·65 Dan. Under similar circumstances a Grove-Landolt element gave the values 1·43, 1·38, and 1·21 Dan. The solution of hydrogen peroxide contained afterwards only 2·16 per cent. H_2O_2. If the solution of hydrogen peroxide was mixed with 1-10th of its volume of sulphuric acid the initial electromotive force was only 1·33. If a saturated solution of common salt was used in place of the dilute acid in which the zinc was plunged the power rose to 1·53 Dan.

A Bunsen element with liquids of similar composition had under the same conditions the electromotive powers 1·67, 1·64, and 1·50 Dan., and after it had remained open for 24 hours, 1·43. A Bunsen-Landolt similarly treated showed 1·41, 1·40, 0·98, and 1·32 Dan. Afterwards the solution contained merely 1·26 per cent. of real hydrogen peroxide. The great decrease of electromotive power after the element had been closed for 50 minutes is here the more remarkable as it did not ensue to the same extent in the Grove-Landolt element. The same considerable falling off of the electromotive power, after having been closed for a length of time, was also observed in a Bunsen-Landolt element in which the solution of hydrogen peroxide had been mixed with 1-10th of its volume of sulphuric acid. Such an element was also something weaker when first put together than one in which the hydrogen peroxide was not acidified. It was also found in this case that the solution, after the element had stood open for 24 hours, contained only 0·70 per cent. of H_2O_2.

Concerning the resistance, I may remark that the Landolt elements without acidulation showed a four or five-fold resistance as compared with Grove and Bunsen elements of the same external form. Acidulation considerably decreases this resistance, but then the evil is encountered that the costly solution of hydrogen peroxide (2s. per lb.) loses its H_2O_2 much more rapidly.

Until the commercial solution of hydrogen peroxide is considerably stronger and cheaper H. Landolt's proposal cannot be recommended in practice.—*Annalen der Physik und Chemie.*

The Electro-Metallurgic Process of MM. Blas and Miest.—The authors have come upon a method for the economical extraction of the precious metals from all sorts of ores of electrolysis. They have established the novel fact that if in electrolysis we substitute for the metal of the anode sulphuretted ores, these latter serve as anodes. Further, if we place such anodes in a bath of a suitable electrolytic salt, and of the same metallic base as the metal of the ore, and allow the electric current to act in such a bath, the result is that all the sulphur of the ore is precipitated upon the anode and falls thence to the bottom of the bath. In the meantime there is formed at the cathode a precipitate or constant deposit of metal liberated from the salt of which the electrolytic bath is formed. On the other hand, the acid of the bath as it is set free approximates an equivalent proportion of the metal contained in the arc. In this manner the neutral electrolytic bath is incessantly reconstituted and serves indefinitely.—*Cosmos les Mondes.*

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

The following returns have been recently filed:—

Anglo-American Brush Electric Light Corporation (Limited).—The second annual return of this company was filed on 10th February. The nominal capital is £800,000, in £10 shares. 40,000 shares had up to the 26th of January been taken up. Upon 13,001 shares the full amount has been called up, and £4 per share upon the remaining 26,999. The total of calls paid is £238,006.

Maxim-Weston Electric Light Company (Limited), formerly the Electric Light and Power Generator Company (Limited).—The second annual return of this company, made up to the 11th of July, was filed on 18th July. The nominal capital is £172,500, in £1 shares, the whole of which have been taken up as follows, viz.:—100,000 by the public; 50,000 (fully paid) by the vendors; 22,500 by patentees. The full amount has been called up. The calls paid amount to £99,997 10s., considered as paid to £72,500, leaving £2 10s. unpaid.

Consolidated Telephone Construction and Maintenance Company (Limited).—The second return of this company, made up to May 8th, was filed on July 27th. The nominal capital is £300,000, in £1 shares. 154,165 ordinary and 45,835 vendors' shares have been taken up. The full amount has been called and paid upon the ordinary shares, and the vendors' shares are considered as fully paid.

Phœnix Electric Light and Power Company (Limited).—The return of this company, made up to September 18th, was filed September 26th. The nominal capital is £250,000, in £1 shares. 58,691 shares have been taken up. Upon 13,661 shares there has been a call of 15s. per share, and upon 30 £1 per share, the remaining 45,000 shares being issued to the vendors as fully paid. The calls paid amount to £8,149 12s. 6d. and unpaid to £2,126 2s. 6d.

Electric Works Company (Limited).—The return of this company, made up to the 12th inst., was filed 14th inst. The nominal capital is £50,000, in £1 shares. 37 shares have been taken up, the full amount being called upon 7, and 5s. per share upon the remaining 30. The calls paid amount to £14 10s.

Jablochkoff Electric Light and Power Company (Limited).—The return of this company, made up to the 29th ult., was filed on 2nd inst. The nominal capital is £300,000, in £5 shares. 18,961 shares have been taken up and £3 10s. per share called thereon. The calls paid amount to £47,194 5s. and unpaid to £19,169 5s.

Stuart Electric Light and Power Company (Limited).—The return of this company, made up to the 2nd inst., was filed on 13th instant. The nominal capital is £60,000, in £2 shares, the whole of which have been taken up and fully paid.

NEW PATENTS—1882.

4845. "Galvano-electric batteries." J. Oliphant and E. B. Burr. Dated October 12.

4869. "Electric lighting." W. Strickland. Dated October 13.

4878. "Galvanic batteries." G. C. V. Holmes and S. H. Emmens. Dated October 13.

4880. "Electric arc lamps." A. M. Clark. (Communicated by W. S. Parker.) Dated October 13.

4883. "Electric lamps." P. R. de Faucheux d'Humy. Dated October 14.

4884. "Systems of electrical distribution and apparatus, or means for regulating the current in such systems." T. J. Handford. (Communicated by T. A. Edison.) Dated October 14.

4889. "Improvements in apparatus for the development of electricity, which improvements consist in a cast helix, or metallic helices, struck in dies from copper, or other metals, or the compounds of metals." J. Whitley. Dated October 14.

4903. "Galleries or brackets for holding globes or lamp-bowls (for electric, gas, or oil lamps) or other fragile articles." C. Ferranti. Dated October 14.

4911. "Electric lamps." J. Allmann. (Communicated by L. E. Schwerd and L. Scharnweber.) Dated October 16.

4915. "Switches for electric lamps." T. W. Cowan. Dated October 16.

4919. "Improvements in the means or apparatus for synchronising or controlling standard and other clocks by time signals, and for utilising the time signal wires for telephonic or telegraphic purposes." J. A. Lund. Dated October 16.

4921. "Voltaic batteries." J. L. Henderson. (Communicated by A. Blondin.) Dated October 16.

4928. "An improved dynamo-electric machine." A. C. Elliott. Dated October 17.

4930. "A new or improved electric arc lamp." C. S. Snell. Dated October 17. (*Complete.*)

4931. "Electric motors." A. G. de Neeff and E. Desfossés. Dated October 17.

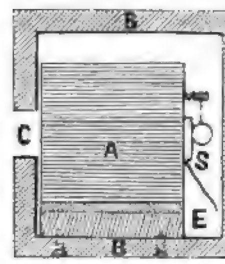
4971. "Electric alarm apparatus for the detection of burglars and for similar purposes." M. H. Kerner. Dated October 18.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

986. "Dynamo-electric machines." W. H. Akester and T. B. Barnes. Dated March 1. 6d. This invention has for its object to increase the efficiency of dynamo-electric machines, and to diminish the cost of their construction. In machines made with the improvements the stationary parts comprising the field-magnets with their exciting electric coils and the pole-pieces may be arranged as in some existing machines, the present invention dealing principally with the rotating parts, or armatures, and the commutators. In one modification there are two compound rotating armatures on one horizontal shaft; and there are two field-magnets which are bars parallel to and on opposite sides of the shaft, and which have pole-pieces at their ends, the northward and southward pole-pieces of one field-magnet being arranged to face the southward and northward pole-pieces of the other field-magnet. One of the compound armatures is between each pair of pole-pieces, the inner faces of which are made cylindrically concave so as to encircle the armatures.

1044. "Telephone transmitters." R. Theiler and M. Theiler. Dated March 4. 6d. This invention relates to the construction of apparatus used for the electrical transmission of articulate speech and known by the name of microphone. Such apparatus invariably consists of two or more conductors of electricity in contact with one another, and to which vibratory motion is imparted by the voice or other source of sound. This vibratory motion of the conductors produces a vibratory current in the circuit connected thereto, and thus the waves of sound are converted into waves of electricity. The novelty of the invention chiefly consists in the means used for communicating the sound vibrations to the conductors, and in the substitution of metallic conductors for the carbon hitherto solely used in apparatus of this kind. The inventors use no tympanum or diaphragm to receive the sound vibrations and communicate them to the conductors, but cause the said vibrations to impinge upon some fibrous or cellular substance, such as cane, whalebone, pith, pine wood, or other material capable of readily transmitting sound. The shape of this substance is immaterial, it is preferred to make it cylindrical or cubical, and to fix it in such a way that the vibrations impinge upon one end or cross cut of the substance while the microphone is attached to the other end or cross cut. By thus substituting a solid block or a bundle of either of the substances named for the tympan or diaphragm used in other transmitters, the inventors attain greater distinctness in the articulation transmitted and by making use of the longitudinal vibrations of a sound conductor instead of the lateral vibrations of a tympan or diaphragm they prevent too violent agitation of the contacts and the breaking of the circuit resulting therefrom. It is not necessary that the said sound-conductor be a fixture, it may be merely suspended. Hitherto only carbon contacts were known to possess the property of varying their conductivity in exact proportion to the amplitude of the vibrations

FIG. I



imparted to them, and carbon was therefore necessarily used in all successful telephone transmitters. After prolonged researches and experiments the inventors have discovered that metallic contacts made of tellurium, molybdenum or manganese either pure or alloyed with other metals, possess the same property as carbon, and they therefore use any of the named metals or their alloys in the place of carbon for transmitting speech electrically. The figure represents a cubical or cylindrical block of any of the substances just now named, fixed to the case, B, of the transmitter in such a manner that one end or cross-cut thereof faces the aperture, C, while the other end or cross-cut carries the microphone, S. The fine parallel lines represent the fibre or grain of the substance. In order to prevent any but those vibrations which impinge directly upon the said block through the aperture, C, from being communicated to the microphone, S, the inventors insulate the block, A, acoustically from the case, B, by inserting some sheet india-rubber, E, or other suitable material between A and B, as shown. The india-rubber is attached by means of cement to the surfaces with which it is in contact.

1067. "Self-acting block signalling apparatus." Eugène Callot. Dated March 6. 6d. The object of this invention is to produce an apparatus which shall effect the automatic putting on and taking off of the optical discs or signal arms usually employed on railways, in such manner that every train passing over an apparatus of this kind sets behind itself an optical signal placed at the preceding apparatus, which signal shows "danger," or blocks the next following train until the first one has passed over the next apparatus. By means also of this apparatus each train places on the line at a certain distance behind it explosive signals which warn the persons in charge of the next train if from any cause the optical signal has been disregarded. The general arrangement is as follows:—When a railway train passes over the first apparatus a pedal in the latter is pressed down, is held in a given position, and the signal arranged at the departure station is put on. When the train passes the second apparatus its pedal is likewise pressed down, and the signals placed at the first apparatus (the optical and the explosive signals) are brought into the position for covering the said train, whilst the first-mentioned signals are taken off. At the passage of the third apparatus the pressure on its pedals takes off the signals at the first apparatus and puts on those at the second. Thus each train always leaves behind it an optical and an explosive signal at a certain minimum distance according to circumstances, and a train following the first one cannot enter the covered zone without the aforesaid signals informing the persons in charge of such train of the presence of a preceding train.

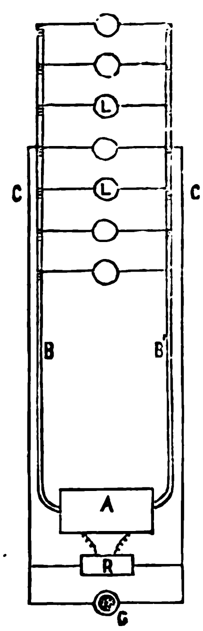
1079. "Incandescent electric lamps." W. Crookes. Dated March 6. 4d. This invention is for improvements in various matters connected with the construction of incandescent lamps. For forming the carbon filaments, the inventor uses, instead of the vegetable matter referred to in former patents, animal fibres, such as silk, hair, wool, silk-worm-gut, or animal matters, such as horn, or gelatine and parchment. These are treated with cuprammonia, and carbonised in the same way as with vegetable fibre, but more slowly, to prevent tumefaction. Some of the above substances are capable of being completely dissolved in cuprammonia, and can then be deposited in a filament in the same way as cotton wool.

1094. "Holders for electric lamps." E. H. Johnson. Dated March 7. 6d. Has for its object the production of a socket or holder for electric lamps, which shall possess the advantages of simplicity in construction (being composed of only a small number of simple parts), non-liability to derangement, and facility for attachment and detachment of the lamp without the aid of any tool or instrument.

1136. "Electric telegraphs." Sydney Pitt. (A communication from abroad by H. C. Mance, of India.) Dated March 8. 4d. The object of the invention is to improve the arrangements for translation of signals automatically between two cables, or between a cable and land line, when relays of an extremely sensitive or unstable character are employed. Although designed more especially to meet the requirements of the Brown-Allan relay, the system can be worked in connection with other relays and telegraph apparatus. The inventor joins up four Morse sounders, or recorders, with clockworks, suitable for double current cable translation, in such manner that notwithstanding the unstability of the relays at the translation office, and the possibility of their coming to rest with the local circuits, some-

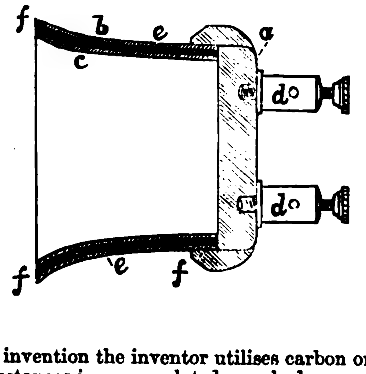
times open, and at other times closed, the distant station on the left is not cut off in the translation apparatus, or prevented from replying when the distant station on the right ceases sending, and *vice versa*. (*Provisional only.*)

1162. "Apparatus for the distribution and regulation of electric currents." W. R. Lake. (A communication from abroad by H. S. Maxim, of America.) Dated March 10. 6d. This invention relates to the distribution and regulation of electric currents supplied from a central or main generating station to devices for utilising the same, as in the deposition of metal, or in the production of heat, light, or power, and it is more especially applicable to systems of lighting in which a large number of incandescent lamps is employed, its object being to maintain a constant ratio between the amount of current generated or thrown into the line and the number of active lamps in circuit. In the figure, A indicates the position of the generator or generators, from which the conductors, B, B¹, extend to a distant group of lamps, L, L. C, C¹, is the regulator circuit, taken off from the main wires at a point as near as practicable to the centre of the group of lamps. The wires of this circuit, C, C¹, are brought



back to the station, where they are connected through the regulator, R, and through a galvanometer, G, which is used in its ordinary capacity to indicate the condition of the line. By these means the regulator, when once adjusted, is controlled entirely by the variations in resistance due to the removal or insertion of the lamps, as, whatever the resistance of the regulating circuit may be, it is affected in the same manner as though it were taken from the main wires close to the generator in cases where the resistance of the main conductors is inappreciable, and in this manner generally when the resistance of the main conductors, intervening between the source of supply and the branches or cross circuits containing the lamps, amounts to an appreciable element of the total resistance of the circuit, the inventor controls the amount of current generated or thrown into the line by means of a regulator included in a branch, or derived circuit, which is taken off from the main conductors at, or near, the centre of the group of lamps, and brought back to the generator.

1177. "Telephones." J. D. Husbands. Dated March 10. 6d. Relates to telephones and is designed to provide for the construction of instruments which shall be as efficient as, and much simpler and cheaper of construction than, any of the telephones now in use. According to this invention the inventor utilises carbon or other suitable conducting substances in a granulated, crushed, or pulverised condition as a medium for transmitting the sonorous vibrations from the instrument to an electric current in the circuit in which the said instrument is included, and the said invention consists in the combination with suitable chambers or cavities, without a diaphragm, of a tension regulator, consisting of carbon or similar material in the above condition so placed between the electrodes as to microphonically regulate the strength of the current. The figure shows one arrangement of the invention. It consists of a block, *a*, of ebonite, wood, or other suitable insulating or non-conducting material and attached thereto is the mouth-piece which consists of two cylinders, short tubes, or funnels, *b*, *c*, of brass or other suitable material, which form the electrodes or conducting surfaces between which the regulator is placed. These cylinders are of such different diameters that when one is inserted centrally within the other there will be between the electrodes and all around the same an annular space as shown; *d*, *d*, are the terminals for the connection of the telephonic circuit wires. The granulated or pulverised carbon or other material is placed, as shown at *e*, in the said annular space between the two cylinders, *b*, *c*, and the ends thereof are packed with cloth, india-rubber, or other flexible non-conducting material, as shown at *f*, to prevent the displacement of the granulated carbon or other material used as the tension-regulator.

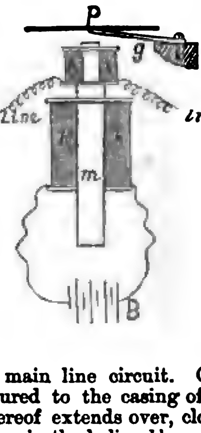


1199. "Electric lamp." Rankin Kennedy. Dated March 13. 6d. Relates to a new or improved electric lamp of the arc type, and consists in making the regulating apparatus of two coils of wire, one fixed and forming a solenoid of thick wire, the other coil being wound on a soft iron tube and of very fine wire. This tube carrying the fine wire coil slides easily inside the solenoid. To the lower end of the iron tube is fixed the upper carbon, a cross-bar carrying two pulleys acting against two guide-rods steadies this carbon and the lower end of the iron tube. The lower carbon is also fixed in a cross-bar running on pulleys on the guide-bars; the upper and lower cross-bars are attached to each other by cords passing over pulleys, so that when the upper carben rises the lower one falls, and *vice versa*. One of these pulleys has a ratchet and pawl on it, so that it can only rotate in one direction. When current electricity is passed into the lamp, the whole current passes through the thick wire coil and thence through the carbons, this current passing through the thick wire coil acts on the iron tube and draws it up, causing the two carbons to recede from each other. Immediately the carbons begin to recede a part of the current begins to pass through the fine wire coil in such a direction as to cause the iron tube to be repelled downwards, the rising of the tube (and with it the carbon) is thus checked at a certain distance, proportional to the difference between the drawing up power and the repelling power; by this means the space between the two carbon points is always maintained the same. Should the two carbon points come too close, the thick coil becomes most powerful and the tube is drawn up; should the points become too far apart, the coil on the tube becomes most powerful, and it is repelled so that a balance is set up whereby the two carbon points are maintained at a uniform distance apart. The ratchet on the pulley checks its turning to allow the carbons meeting, so that the friction of the cord slipping over it lessens the suddenness of the repelling power. By these means a steady uniform light is kept up between the two carbon points.

1201. "Dynamo-electric or electro-dynamic machines." R. Matthews. Dated March 13. 2d. Has for its object the constructing of dynamo-electric or magneto-electric and electro-dynamic machines in such a manner as to be able to give a continuous electrical current as regards direction, and practically of uniform strength. (*Provisional only.*)

1249. "Armatures for magneto-electric machines, &c." C. L. Levey and E. Lumley. Dated March 15. 6d. Relates partly to the construction of armatures for magneto-electric machines, and particularly to that class known as "ring" or "Gramme" armatures; and this part of the said invention has for its objects the simplification of construction, accuracy and facility in securing the supporting shaft concentrically therein, the winding of the induced conductor in uniform and equal sections or bobbins, and the dissipation of heat by conduction and radiation.

2259. "Apparatus for the transmission, &c., of sounds by electricity." W. C. Barney. One part of the invention relates (according to the inventor) to improvements of an instrument for the reproduction of sound invented by Philipp Reis. One form of the improved instrument is made in the following manner—On a straight bar, *m*, of soft iron is placed a helix, *h*, the covered wire wound thereon being in the circuit of a battery, B, with a second helix, h^1, placed on the end of the bar, *m*, the covered wire wound



thereon being in the main line circuit. One extremity of a steel spring, *g*, is firmly secured to the casing of the electro-magnet, *m*, the other extremity thereof extends over, close to, but not in contact with, the end of the core in the helix, h^1, and against this end of the spring, *g*, is firmly held a plate, *p*, at right angles to the axis of the helix; this plate may be made of cardboard cork, wood, glass, [illegible] mica, iron, or steel, or of any equivalent material which [illegible]

may not, be capable of inductive action, and the plate may be round, oval, oblong, triangular, or rectangular, and it must be clamped firmly around its edges, sides, or points, between parts of the casing of the electro magnet.

2531. "Armatures for electric machines." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, America.) Dated May 27. 6d. Has for its object to secure the annular core portion or armature proper to its hub or shaft in a positive and rigid manner in its direction of rotation, so as to obviate the displacement of the armature or its coils by the strains to which it is subjected when in use.

2563. "Electric lamps or lighting apparatus." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, New York.) Dated May 31. 6d. Relates to arc lamps and to devices for cutting a faulty lamp out of circuit when its arc fails, or when the arc becomes abnormally long by failure of the feeding mechanism or by other causes.

2570. "Electric lamps." W. R. LAKE. (A communication from abroad by J. J. Wood, of New York, America.) Dated May 31. 6d. Relates to that class of arc-lamps known as "double or duplex" lamps, which are provided with two or more sets of carbons and corresponding holders, the second set of which is thrown into luminous action as soon as the first set is exhausted, whereby the light of the lamp is continued, without interruption or attendance, over a longer period. The object of the present improvements is to provide a simple and efficient apparatus of this character which will embody two or more sets of carbons in such a way that one set only will be in action at one time, and the strain of one only will be borne by the regulating mechanism and its magnets or other motor, so that such mechanism and motor shall have only the same work to perform as it has in an ordinary single lamp, and will require no increased dimensions, power, or consumption of current, as is the case with duplex lamps, heretofore produced, in which the strain of both carbons is constantly borne by the magnet, and both are moved at the same time, one slightly in advance of the other.

2623. "Devices for coupling the armatures and commutators of electric machines." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, New York). Dated June 3. 6d. Relates more especially to the Gramme form of armature and commutator, and it consists in an improved device for connecting or coupling the ends of the armature coils with the commutator strips or sections.

DISCLAIMER.

2909***. 1877. "Controlling by sound the transmission of electric currents and the reproduction of corresponding sounds at a distance." The United Telephone Company's disclaimer and memorandum of alteration. Edison's patent.

CITY NOTES, REPORTS, MEETINGS, &c.

THE ELECTRIC NEWS-TELEGRAPH COMPANY (LIMITED).

UNDER the presidency of Sir Michael Kennedy, the statutory meeting of the shareholders of the above-named company was held on the 13th inst., at Cannon Street Hotel.

Mr. John Cooper, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, this is our first general meeting, called merely in compliance with the statute, therefore we shall not have very much to tell you on this occasion. I have just thrown together a few remarks, which I will read to you. The company was incorporated on the 5th of June. The total number of shares issued was 7,805, representing a nominal capital of £39,025. The amounts due on application and allotment, and on first call, have been all received, with the exception of a small sum which is now in process of adjustment. The terms of payment to the vendors were altered from those stated in the prospectus of the company, by the reduction of the cash payment from £23,500 to £6,000, and £3,000 in debentures, and by a corresponding increase in fully paid-up shares. When the company's prospectus was issued, an opposition of a most determined and virulent character was offered by the Exchange Telegraph Company, who went to great expense in advertising a statement calculated to damage the company's prospects in obtaining capital. They stated that the Exchange Telegraph Company could use the instrument of this company, which they alleged to be an infringement of their patents; and it became necessary to issue a counter-statement to show that those claims were unfounded. Although there was no doubt on the subject, it was thought advisable, as this statement had been made, before proceeding to allotment to have further expert opinion on this point, and the matter was submitted to an eminent electrician, Professor F. Jenkin, who reported as follows:—

"6, DUKE STREET, ADELPHI, LONDON, W.C.,
"*July* 14*th*, 1882.

"SIR,—In answer to your request that I should advise your board concerning an advertisement which appeared in *The Times* of 30th June, headed, 'The Exchange Telegraph Company,' I have now the honour to report as follows:—

"I have looked through five patents which I am informed belong to the Exchange Telegraph Company.*

"I have also looked through two patents which I am informed belong to the Electric News-Telegraph Company; these are No. 5,162 of 1880 and No. 1,853 of 1882.

"I have seen the two instruments of the Electric News-Telegraph Company constructed in accordance with the last-mentioned specifications. Both are good instruments, and I consider the later form, which is made in strict accordance with specification No. 1,853 of 1882, to be an improvement on the earlier form. The new instrument is, in my opinion, excellent and especially adapted for use where, as in your business, many instruments are placed in one circuit.

"In the advertisement referred to above a specific allegation is made that the Exchange Company are entitled to use under their patents everything contained in your instruments. In answer to this it is only necessary to say that the instruments which you use are made in strict accordance with the specifications of your patents. These patents are in force and must be proved invalid before your instruments can be used by others.

"Under the fifth head in the above-named advertisement two statements are made—First, That the 'peculiar self-adjusting appliance' used in your later instruments is not identical with that used in the earlier instruments; this may be true, but it is irrelevant, as no assertion of identity was made by you. The second statement affirms that your new self-adjusting appliance is the subject of a patent belonging to the Exchange Telegraph Company.

"In reading the patents belonging to the Exchange Telegraph Company, I attended specially to this point, and I am clearly of opinion that these patents give them no claim which can interfere with your new 'self-adjusting appliance.'

"Under the sixth head of the above-named advertisement, it is stated that the directors of the Exchange Company consider it an error to say that the whole of the varied movements of your instrument are regulated by a single wire. There was no error in your statement, your instruments are worked and regulated through one wire, and this fact gives your instruments an important advantage over others.

"I am, Sir,
"Your obedient servant,
"FLEEMING JENKIN, F.R.S., &c.

"W. J. BURNSIDE, Esq.,
"Managing Director, Electric News-Telegraph Company.

"*P.S.—The patents I have examined of the Exchange Company are 1,657 of 1870, 1,400 of 1871, 2,576 of 1873, 1,475 of 1877, 4,628 of 1880."

It was a matter of great regret that the Exchange Telegraph Company should think it fit to adopt the tactics they did, and should have endeavoured to crush this company at its birth by measures which could hardly be considered fair or justifiable. It was no subject for surprise that they should have felt the danger of the rivalry about to spring up; and the fear of the effect of the establishment of a better, a newer, and a cheaper instrument on the monopoly they had so long enjoyed. Their efforts to crush the company were, however, unavailable; sufficient money was subscribed, and the manifestation of feeling the Exchange Company gave to the new competition is one of the best proofs of the merits of the invention of the company. This company was established to take over a young, but growing concern. At the time we took it there were only 82 subscribers, with an annual income of, say, £2,370; there are now 118 subscribers, paying annually a sum of, say, £4,660, an increase of more than 50 per cent. in about four months. And the business is still steadily increasing, notwithstanding the fact that since the commencement of the company's operations it has been the slack period of the year, during which it is not to be expected that the same amount of business can be done as we may confidently look forward to at the more busy period. The outgoings of the company are at the rate of, say, £5,000 per annum; so that there is already nearly an equilibrium between outlay and receipts, and as preliminary and many general charges are provided for, fresh subscriptions will go to profit; and I think as regards our home business our prospects are very encouraging. We are now in negotiations for the sale of our patent rights out of England. These negotiations, though in a very advanced stage, have not been finally concluded. I hope we shall shortly be in possession of results very favourable to this company. For obvious reasons, it will not be well for me to enter into details on this subject, and I am sure you will see this. Your directors have your interest entirely at heart, and with the assistance of your able and energetic managing director, Mr. W. J. Burnside, will do all in their power to secure those interests.

Mr. Keen: I hope there is no fear of litigation with the rival company?

The Chairman: I don't think so. We have had no indication of anything of the sort, or anything on their part to oppose us, or they would have done so before now. I think they have no chance of succeeding in any attempt they may make in that direction.

A Director: We hope it may be the other way on.

The Chairman: If no other gentleman has any question to ask we will consider the proceedings have terminated.

Mr. Hunt proposed a vote of thanks to the Chairman, which was seconded by Mr. Keen, and

The Chairman in reply remarked that his own opinion certainly was that the undertaking would prove a very successful affair, and they could already see indications of that.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

THE report of the directors states that the accounts for the year ending 31st December, 1881, show the gross revenue to be £32,356 15s. 11d. against the sum of £17,398 14s. 2d. for the previous year, leaving a net balance of profit of £1,308 13s. 6d.—a result which may be looked upon as satisfactory, regard being had to the continuance of the deplorable war between Chili and Peru; and considering that the company's terminal station at Lima was only open for traffic for half of the year, whilst Mollendo, another of the company's stations, was blockaded by the Chilian fleet during the whole of the year. Not-

withstanding, however, the continuance of active hostilities and the utter stagnation of trade at Lima, and at other places on the west coast, the board are glad to report that the income of the company continues to increase, and that the next balance sheet of the company, which will be issued at an earlier date, will show a considerable improvement in its position and prospects. The interest upon the debentures of the company has all been paid and the amounts included in the balance sheet in the item £8,299 15s. 8d. "Outstandings due by company" have been paid also. The expenditure of the repairing steamer *Retriever* shows a sensible decrease, whilst her earnings show a material increase of £2,286 6s. 10d. For the current year she has been employed in assisting to lay the new cables on the Pacific coast, and has earned up to this time £6,900, an amount considerably in excess of her earnings for the corresponding period of last year. The net increase in the income of the company for the present current year amounts, so far as it has already been ascertained, to a sum of about £7,000. The board regret that despite their anxious and unceasing efforts they cannot as yet announce a settlement of the company's claim upon the Chilian Government. It is not advisable at the moment to enter into details, but it may be stated that, yielding to the influences brought to bear by the board, the Chilian Government not only assented to the appointment of arbitrators in the matter, but it has in a sense anticipated their decision by offering a sum of money in settlement of part of the claim, leaving the other part to be prosecuted hereafter. This offer the board have declined, and instructions have been sent out to the coast for the claim to be urged and pressed forward in every way compatible with the interests of the company, and with the present difficult position of the Chilian Government. Regarding the prospects of the company, the board are pleased to announce to the shareholders that the new cables of the Central and South American Telegraph Company, extending for some 3,000 miles along the Pacific coast, have been opened for public traffic this week. These cables, completing the circle of the South American Continent, give this company a new route, and establish direct communication from Valparaiso to the whole of the Central American Republics, to the United States, and to England. Agreements have been completed by the board with the Central and South American Telegraph Company and with the Mexican Telegraph Company, for the transmission and exchange of the traffic which this company will obtain through the opening of these new and extensive lines. With a cessation of hostilities, and anything like a revival of trade upon the coast, these lines should bring a marked accession to the business of the company. The board regret to report the untimely death of Mr. Rose-Innes immediately after his return from the west coast, where for some months he had rendered valuable service in looking after and promoting the interests of the company. The members of the board retiring by rotation are Mr. Matthew Gray and Mr. Robinson Kendal, both of whom being eligible, offer themselves for re-election. The vacancy caused by the death of Mr. Rose-Innes the board do not propose to fill up at the moment.

Annexed to the above report is a list of the cables and land lines of the company with their lengths in nautical miles. Cables.—Valparaiso to Serena, 219·03; Serena to Caldera, 215·34; Caldera to Antofagasta, 229·00; Antofagasta to Iquique, 250·50; Iquique to Arica, 128·35; Arica to Mollendo, 146·42; Mollendo to Chorrillos, 510·08. Land-lines.—Chorrillos to Lima, 11·00; Lima to Callao, 7·00. Total, 1716·72.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

The report of the directors, to be presented to the eighteenth half-yearly general meeting, states that the revenue for the half-year ended 30th June, 1882, amounted to £88,842 3s. 3d.; and the working expenses (including £10,609 7s. 11d. for repairs of cable) to £23,155 12s. 6d. After providing £1,101 18s. 6d. for income-tax there remains a balance of £64,584 12s. 3d.; to this is added £38,710 12s. 1d., the undivided profits to 31st December last, making a total of £103,295 4s. 4d. From this amount there is deducted £19,500, the third interim dividend paid 24th June last, and £50,000 transferred to the reserve fund, leaving a balance of £33,795 4s. 4d. The directors now recommend the declaration of a final dividend of 3s. per share, making a total dividend of 6 per cent. for the year ended 30th June, 1882, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the past year, leaving a balance of £1,295 4s. 3d., to be carried forward. Early in May last another fault occurred in the shore end at Pernambuco, which developed to such an extent as to cause a total interruption before the end of the month. A temporary repair was promptly effected by the company's superintendent, Mr. Howe, and at the end of June the s.s. *Kangaroo* laid a new shore end, bringing the electrical condition of the cable to the same state of perfection as when first laid. Since the last general meeting a serious fault has developed in the Lisbon-Madeira section, in consequence of which the directors have thought it desirable to make an agreement with the Telegraph Construction and Maintenance Company for the manufacture and laying of a duplicate cable for that section at a cost of £100,000, which will be taken from the reserve fund. The directors regret to announce the recent death of their colleague, Mr. Matthew Hutton Chaytor. The directors have, under the powers given them by the articles of association, elected the Hon. William St. John F. Brodrick, M.P., to fill the vacancy occasioned by the death of Mr. Chaytor. Two of the directors, Mr. C. F. dos Santos Silva and Mr. Frederick Youle, retire by rotation at this meeting, but being eligible for re-election, they offer themselves accordingly.

Messrs. Ferranti, Thompson and Ince (Limited), notify that they have removed from 110, Cannon Street, to 3, Fenchurch Avenue.

Cable Repaired.—The cable between Guadaloupe and Dominica has been repaired. Communication with the islands of Dominica and Martinique is therefore restored.

The Direct Spanish Telegraph Company (Limited).—We are informed that this company's rate to Valparaiso and other stations in Chili has been reduced from £1. 4s. to 14s. 8d. per word.

Mr. John Pender sailed from the United States for Europe on the 17th inst., in the steamer *Alaska*. It is reported that a hitch has occurred in the negotiations with Mr. Gould. The Western Union, being satisfied with the recent contract for an exclusive interchange of business with all existing cables, is unwilling to modify or permit the cables to receive business from other sources. Mr. Pender's object, it is supposed, is to prevent the laying of the cable projected by Garrett, the president of the Baltimore and Ohio Railway, connecting with the Mutual Union Telegraph. He declined the proposed directorship of the Western Union Telegraph Company.

Application has been made to the Stock Exchange Committee to appoint a special settling day in the shares of the Birmingham and Warwickshire Brush Electric Light and Power Company (Limited); also in the shares of the Devon and Cornwall Electric Light and Power Company (Limited), and to allow the following to be quoted in the official list:—Gülcher Electric Light and Power Company (Limited) shares. The Committee have appointed Tuesday, the 24th inst., a special settling day in the Anglo-Austrian Brush Electrical Company (Limited) shares.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. Oct. 18.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	12¾-13¼	13[illegible] 12[illegible] [illegible]
		Do. Do.	10	25 - 29	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1½- 2	1¾
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1½- 1¾	
25,000	5	Great Western Electric Light & Power Co.	2½	1 - 1½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	7½-7¾	7¾.½
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 1¾	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	[illegible]	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1½- 2	1¾
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2½	2½
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	50 - 51	58¾ xd.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	82 - 83	82½ xd.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	20 - 21	20½
130,000	10	Brazilian Submarine, Limited	10	12¼-12¾	12½.[illegible]
16,000	10	Cuba, Limited	10	9¾- 10¼	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	xd.
6,000	10	Do. 10 per cent. Preference	10	15 - 16	15½ xd.
65,000	20	Direct United States Cable, Limited, 1877	20	11¾- 12¼	12[illegible]
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	xd.
380,000	10	Eastern, Limited	10	10¼- 10¾	10[illegible] xd.
70,000	10	Do. 6 per cent. Preference	10	12¾- 13	12[illegible] xd.
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	xd.
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	101 -104	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11[illegible]- 11[illegible]	11[illegible] xd.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6[illegible]
163,209	10	Do. 6 per cent. Preference	10	12¼- 12¾	
125,000	10	Great Northern	10	12¼- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	101
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	27 - 28	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	31 - 32	31½
38,148	10	London Platino-Brazilian, Limited	10	4½- 4¾	4¾
12,000	10	Mediterranean Extension, Limited	10	1½- 2½	
8,200	10	Do. 8 per cent. Preference	10	8 - 9	
9,000	8	Reuter's, Limited	8	12½- 13	xd.
280,000	Stk.	Submarine	100	260 -280	
58,225	1	Do. Scrip	1	2[illegible]- 2[illegible]	2[illegible]
4,200	Cert.	Submarine Cables Trust	100	102 -106	101 xd
37,350	12	Telegraph Construction and Maintenance	12	30½- 31½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	[illegible]	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100		
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100		
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000		
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100		
88,321	10	West India and Panama, Limited	10		
34,563	10	Do. 6 per cent. 1st Preference	10		
4,669	10	Do. 6 do. 2nd do.	10		
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	[illegible]	
100,000	5	United Telephone Co.	5	10[illegible]	

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 257.

THE ELECTRIC LIGHT AT CHESTERFIELD.

We learn, through the columns of the *Derbyshire Courier*, that the Chesterfield Town Council on Tuesday, the 10th inst., unanimously decided to adopt the recommendation of the Watch Committee in favour of applying for a licence to supply electricity for public and private purposes within the borough. At the meeting some of the many advantages derived from a local authority having the lighting of a district in its own hands were pointed out, and not a single member had anything to say against the proposal. The Council will not be required to spend anything in the purchase or maintenance of plant, but the Act gives power to a local authority to contract with any company or person for the supply of electricity in the area to which their licence extends. The Corporation would thus be bound to no particular system of electric lighting; they could require all wires to be placed underground; they could exercise a control over the breaking up and re-laying of the streets, and any profits which might be derived would go to relieve the rates.

The lighting of this town has been referred to on several occasions in the Electrical Review, and last week we published in our "Correspondence" columns a letter bearing upon the subject. It will be remembered that the Hammond Company contracted to light Chesterfield for a year, after an efficient trial, by means of "Brush" arc electric lamps and incandescence lamps of the Lane-Fox system.

Mr. Alderman Gee, who apparently takes a leading part in connection with this matter, recently ventilated his views in the *Standard*, and he came to the conclusion that the efforts of the Hammond Company were, to say the least, a failure, more especially as regards the incandescence lamps. He admitted, however, that the arc lights are doing good service in some of the streets. With these we do not intend to deal, as the lamps on the incandescence system claim most attention at present. The Mayor of Chesterfield, in the course of his remarks, spoke to the following effect:—"Some possessed an illuminating power which really surprised him, the amount of light they gave being equal to 15 or 16 candle-power, whilst other lamps were as low as five or six candle-power. That was the cause of very [illegible] disappointment. Those differences were not occa[illegible]he current of electricity passing through the [illegible]se the same strength of current passed through [illegible] difference was owing to the variety of the lamps [illegible]y as to their illuminating power. It was quite [illegible]s the lighting of the town by the electric light [illegible]ceeded to their expectation or to the expectation [illegible]actors."

[illegible] to be found in these observations several points deserving of comment. It is to be feared that sufficient care is not exercised in selecting lamps to be used in installations of incandescence electric lighting. In nearly all cases it is thought that if all the lamps have the same resistance they should produce the same candle-power. This is, however, quite a mistaken idea, as a few words will show. Suppose we have a carbon filament of a definite length and sectional area, and having, say, a resistance of 100 ohms. A given strength of current will heat this filament to, for instance, 20 candle-power. Now it is highly probable that the next lamp we may select has a slightly shorter and thinner filament than the first, and still another may have a filament just a trifle longer and thicker, but both may have a resistance of 100 ohms. The same current, however, which passes through our first lamp, and which produces a light of 20 candles would, in the second case, produce more light, as the mass of carbon to be heated is less; but the third lamp would not give us so much illuminating power, because the mass of carbon to be heated is greater. Therefore, although incandescence lamps may all be brought to the same resistance, we shall get varying illuminating power for a given strength of current, unless we can be sure that the carbon filaments are of the same dimensions and character.

It must be remembered, however, that Mr. Hammond was extremely reluctant to use incandescent lamps at all, on the ground that they had only reached an experimental stage; and, as the Mayor observed on Tuesday, the installation at Chesterfield was the first ever made for public lighting, and the contractors had necessarily to proceed tentatively.

The Mayor remarked further, that "Incandescent lamps had never been employed for street lighting previous to their being used at Chesterfield. His impression was, considering the infancy of the electric lighting, that the company had done wonders. At the same time, he had to confess that they had not accomplished that which they had set out to accomplish, and that for which they had contracted. He believed, however, that they had demonstrated the fact that electric lighting for public purposes was possible; and it had been demonstrated over and over again that the electric light for private purposes was not only possible, but really very convenient, and it might be in a very few years cheaper than, and far superior to, gas."

That the Mayor's belief will shortly be verified seems highly probable. There is little fault to be found now with the lighting of the Holborn Viaduct by the Edison Company since the substitution of a good single lamp for two indifferent ones. Mr. Gordon is also just coming upon the scene with his present installation of 1,300 or more lamps of 22 candle-power each, and his machine, which is said to be capable of supplying 7,000 similar lamps. It is indeed unfortunate that the Lane-Fox lamps should have proved so unsatisfactory in actual practice, and it is doubly so when we take into consideration the fact that Mr. Hammond's contract did not allow him to substitute others. We hope that some information will be forthcoming to account for the poor show made by the Lane-Fox lamps, for on the Holborn Viaduct such variations of light as shown in the streets of Chesterfield is not at any time observable. That the people of Chesterfield as a body appreciate the electric light is certain in spite of Alderman Gee's disparaging

remarks, and it is eminently satisfactory to note that the Town Clerk read a memorial which set forth that lighting by electricity had now become an accomplished fact; that the memorialists believed the light generated by electricity to be the best at present produced; that it would be convenient to the memorialists to have their shops and dwelling-houses lit by means of electricity, and that they therefore submitted to the favourable consideration of the Council the desirability of steps being taken to secure such object. The Town Clerk added that the document was signed by between 300 and 400 highly-respectable inhabitants, headed by Dr. Carnegie.

The experience gained at Chesterfield will not be lost, and whether the local authorities retain their powers in their own hands or whether they employ contractors to do the work for them, we hope shortly to hear that the lighting of Chesterfield by means of electricity is an accomplished fact and a permanent one.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS.

[From *Nature* of the 19th inst.]

PART IV.—*The Function of Sulphate of Lead.*

IN our previous communications on the chemistry of lead and peroxide batteries, we have frequently remarked on the formation of lead sulphate and its importance in the history of a cell.

In Part I.* we showed that the local action that takes place at first energetically between the metallic lead and the peroxide is gradually diminished by the formation of sulphate of lead.

In Part II.* we stated that in the original formation of a Faure cell, sulphate of lead is oxidated on the one plate, and reduced on the other. We also described an experiment in which two platinum plates were covered with lead-sulphate immersed in dilute sulphuric acid, and placed in the circuit of a galvanic current; the result being that "the white sulphate was decomposed to a large extent on each plate, the positive being covered with deep chocolate-coloured peroxide, the negative with gray spongy lead."

In Part III.* we showed that on the discharge of a cell, lead sulphate is the ultimate product on both plates.

It might naturally be inferred from our previous statements that in the re-charging of a cell, this lead sulphate would be oxidated on the one plate and reduced on the other, as in the original formation. This matter, however, has given rise to some controversy. All subsequent experimenters admit the *oxidation* of the lead-sulphate, but Dr. Oliver Lodge could not obtain any reduction of it when pure sulphate was employed. Sir William Thomson also, when experimenting with two platinum plates and layers of sulphate, obtained only a doubtful indication of reduced metal. The question as to whether the sulphate is reduced or not on re-charging a Faure cell is one of vital importance; for if the sulphate formed at each discharge accumulates on the positive plate it would clog up the space, and, what is perhaps worse, a fresh surface of the lead would have to be oxidated (or rather converted into sulphate) at each discharge. Thus the positive plate will be continually corroded, and its life will be limited.

We have already replied to Dr. Lodge in *Nature* (Vol. XXVI. p. 342), but we thought it desirable to repeat the experiment with the platinum plates, especially with a view to determine whether the reduction was effected slowly or with any rapidity. We fastened 20 grms. of the white sulphate upon a negative plate by binding it round tightly with parchment-paper, placed it vertically in the sulphuric acid, and passed a continuous current of somewhat under an ampère. The hydrogen was at no time wholly absorbed—indeed the greater part of it certainly escaped—but after a lapse of twenty-four hours, small patches of gray metallic lead became distinctly visible through the wet parchment-paper; and these gradually spread in an irregular manner. At the end of ten days it was found that the whole of the sulphate, except a few small patches on the surface, was reduced to a gray spongy mass. Although there could be no reasonable doubt that this was metallic lead, a portion of it was tested chemically, and proved to be such.

It thus appears that the *reduction* of the pure sulphate of lead is an absolute fact, although it does not take place so easily as the oxidation.

In an actual cell the sulphate of lead is of course mixed with other bodies. Thus in the formation of a Faure battery, the minium is converted by the sulphuric acid more or less completely into peroxide of lead and sulphate. We have already described an experiment in which 4,489 cc. of hydrogen were absorbed on a plate, the materials of which were capable of absorbing only 4,574, cc., if the whole sulphate as well as the peroxide was reduced. In our note-book we have the particulars of four other experiments made in each case with the same or nearly the same, amount of material, in which 4,199, 4,575, 4,216, and 4,387, cc. respectively were absorbed, although perhaps in not one of these cases was the experiment continued until the action was absolutely complete. As, however, it may be objected that the amount of sulphate produced upon these plates was an unknown quantity, we have in a recent experiment treated the minium in the first instance with a considerable amount of sulphuric acid. This gave us a mixture which, on analysis, was found to contain 18·5 per cent. of sulphate of lead. This mixture, when submitted to the reducing action of a current yielded a mass of spongy lead that contained only a mere trace of sulphate.

As it seemed desirable fully to establish the fact that the sulphate of lead formed on the discharge of a cell is reduced in the subsequent charging, we took the quondam lead plate of a fully discharged cell, determined the proportion of sulphate to unaltered spongy lead, and submitted it to the reducing action of a current. The amount of sulphate in the plate before passing the current was found to be 51 per cent., but, after the passage of a current of about an ampère for 60 hours, not a trace of it remained.

Hence it may be concluded that, during the alternate discharging and re-charging of a Planté or Faure cell, sulphate of lead is alternately formed and reduced on the lead plate, and that the plate itself is not seriously corroded. It would, however, appear desirable not to allow the whole of the spongy lead to be reduced to sulphate during the discharge, for two reasons, viz.: (1) because the supporting plate stands a chance of being itself acted on if there is not a sufficient excess of spongy metal; and (2) because the presence of an excess tends to facilitate the reduction of the sulphate.

We have already shown that sulphate of lead is produced by the local action that takes place between the peroxide and its supporting lead plate during repose. The same local action also takes during the charging of the plate, as was pointed out in our second communication, and this sulphate is [illegible] turn, attacked by the electrolytic oxygen. In this way the absorption of oxygen in forming the negative plate [illegible] never to come to an end. In order to see whether this was the case, we allowed an experiment to continue for 115 hours, although the main action was over in about 40 hours. [illegible] the last two days of the experiment, the amount of oxygen absorbed was pretty constant, being about 9 cc. per hour, which is equivalent to 0·24 grms. of sulphate of lead [illegible] and oxidated. The whole charge on the plate [illegible] grms. of peroxide. This local action also takes place [illegible] the discharge, as is evidenced by the sulphate of lead [illegible] on the negative plate always exceeding in amount that [illegible] on the positive plate.

Through this local action taking place during the [illegible]tion of the cell, during repose, and during the discharge, the lead plate which supports the peroxide must be con[illegible] corroded more and more; and it is probably due to [illegible] solubility of the sulphate formed that the destruction [illegible] kind of secondary battery is so materially retarded in [illegible]

J. H. GLAD[illegible]
ALFRED TRI[illegible]

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* See ELECTRICAL REVIEW, pp. 21 and 211, Vol. X., and p. 64 of Vol. XI.

M. JABLOCHKOFF'S NEW ELECTRIC-MOTOR.

Some weeks since we drew attention to the fact that M. Paul Jablochkoff, during a visit to London, had submitted to the inspection of several scientific friends a new electro-motor of his own invention, at once simple and novel. We were enabled to view M. Jablochkoff's machine, but could not at the time publish any facts concerning the principles on which its construction was based. We are now, however, in a position to lay before our readers a few facts concerning the action of this apparatus.

It seems to be established, according to the experiments undertaken on various occasions upon the transmission of power to a distance, that the modern continuous current dynamo-electric machines—Gramme, Siemens, Bürgin, &c.—constitute very efficient electro-motors.

In fact, if they transform 50 per cent. of the power applied to them into electric energy, they are capable of furnishing also in effective work at least 50 per cent. of the electric energy which is supplied to them from terminal to terminal. This return, however, supposes a few secondary modifications in the dynamo-electric machines employed as motors—such, for example, as the arrangement of the brushes, which ought to be set behind the neutral line with respect to the direction of motion instead of in front.

The experiments made with the object of increasing the efficiency of the motor do not seem therefore justifiable, since this efficiency attains at present a figure which it would be difficult to surpass; but besides this question, there is another which it will suffice merely to state in order to make its importance appreciated. What is the actual price of a continuous current dynamo-electric machine capable of supplying $\frac{1}{10}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, 1, 2, 3, &c., horse-power? Practice shows that the actual machines, for equal efficiency, are more economical in cost price as they become more powerful, but that they are very expensive when constructed to furnish the work of only a few kilogrammetres.

We may therefore seek, with little chance of success, for a small electro-motor giving a satisfactory efficiency and low-priced compared to the quantity of work which it can supply, though the problem to be solved has to some extent been effected by the Siemens armature as applied by Marcel Deprez, Trouvé, and by Griscom.

The principal cause of the high efficiency of the Gramme machine, employed as a motor, results from the fact that the changes of direction of the current, and the reversals of polarity, are produced by successive fractions, in a single section at the time, the magnetic force, which must be overcome, is therefore only felt to an inappreciable extent, and one can counteract its detrimental action by a suitable arrangement of the collecting brushes.

In the double T bobbin-motors of Siemens, the magnetic force is less than in the first motors of Froment, Larmenjeat, Page, Leroux, &c., by reason of the relatively small dimensions of the magnetic masses submitted to the alterations of polarity; this explains why the return from these motors is intermediate between that of the Froment apparatus and the present continuous current machines. There was one more step to advance in this direction by dispensing completely with the magnetic masses submitted to the changes of direction of the current.

At the International Exhibition of Electricity, in Paris, held in 1881, M. Bürgin, of Bâle, exhibited an apparatus founded on this principle, and of which the description was given in the Electrical Review of the 14th January, 1882 (Vol. X., p. 20), translated from *L'Electricien*. We reproduce it again in order that it may be studied side by side with that of M. Jablochkoff.

It consists of a core of iron, B (figs. 1, 2, and 3), wound round with wire, M, the convolutions of which are wound so as to complete a sphere. This core of iron turns on a horizontal axis, the wires, M, which are attached to the sections of a commutator, C, are traversed by a continuous current from the source of electricity (a battery or a dynamo-electric machine) and polarise the extremities of the core of iron, B, without reversing the polarities, notwithstanding the rotatory movement of the core.

The sphere formed by this core and the wire, M, turns inside a second sphere which is hollow and fixed, and on which is wound horizontally a second continuous wire attached to two brushes of the commutator, C.

In consequence of the reciprocal reaction which takes place between the fixed sphere, B, and the movable polarised core inside, and in consequence of the reversals of current produced in the outer sphere, a rapid rotatory movement is imparted to the core and its axis.

This motor is characterised by the following points:—

(1.) The movable part consists of an electro-magnet, the polarity of which is never reversed.

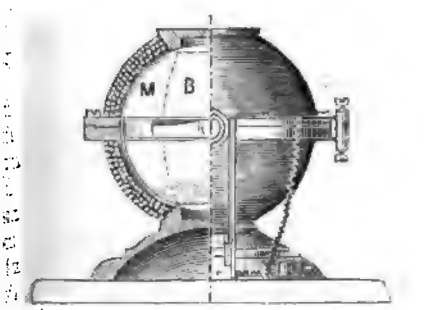

Fig. 1.

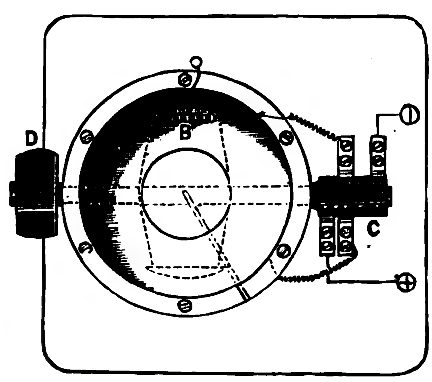

Fig. 3.

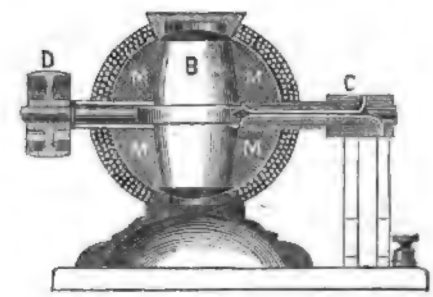

Fig. 2

Bürgin's Electro-Motor.

(2.) The currents are reversed in the fixed part of the motor, and not in the movable part.

(3.) The movements are produced by the reciprocal action of a current and an electro-magnet, and not by the mutual attraction exercised by two electro-magnets.

There is, therefore, with this mode of construction, no magnetic inertia to overcome, since the system works without reversing the polarity of the core.

The motor of M. Paul Jablochkoff, of which we give an illustration (fig. 4) belongs to the same class as the Bürgin machine. It is composed of two bobbins, one fixed upon a horizontal axis in an inclined position, and turning with it; this bobbin is coiled upon a framework of iron, the cheeks of which form two circular poles (north and south), which, by the arrangement of the commutator, change their polarity twice in a revolution; the second bobbin is fixed in a vertical plane more or less inclined in relation to the horizontal axis of the revolving bobbin; it is coiled upon a non-magnetic frame, and the current which traverses it is continuous in direction. It is the relatively inclined position of the two bobbins which has given the apparatus the name of ecliptic, by reason of the analogy which this inclination presents to that of the ecliptic upon the equator.

The apparatus has arrangements for varying the inclination of the two bobbins so as to determine the best conditions for working; but in the motors for commercial purposes the position of the bobbins, determined once for all, will be fixed and invariable. When studying the mutual action between the movable electro-magnet upon its horizontal axis, which is submitted to the alterations of direction of the current, and the fixed solenoid in which a continuous current circulates, we see that there must result from it a

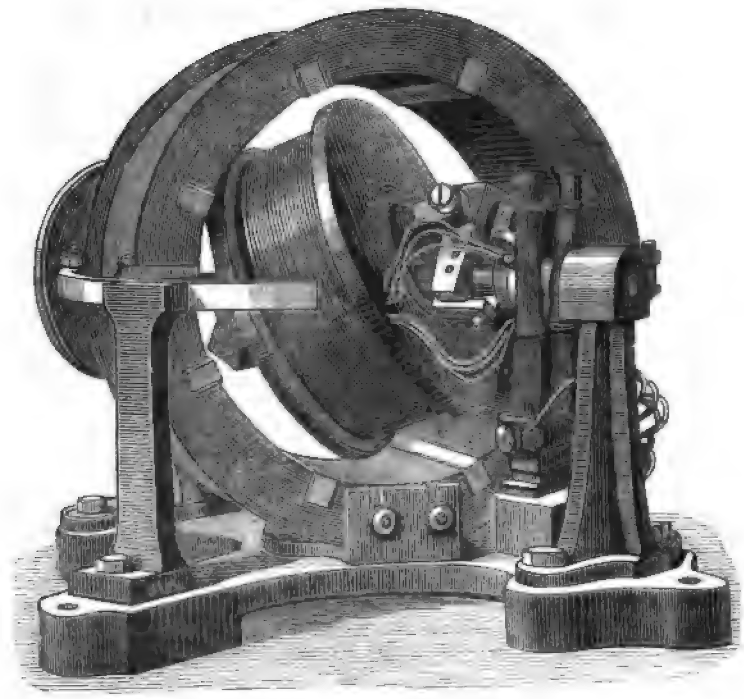

Fig. 1.

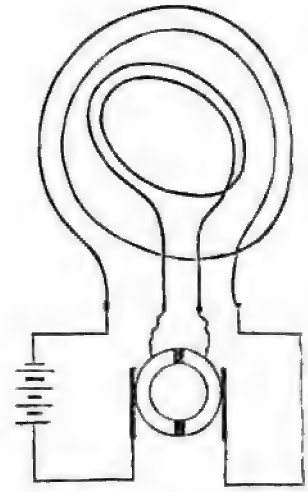

Fig. 5.

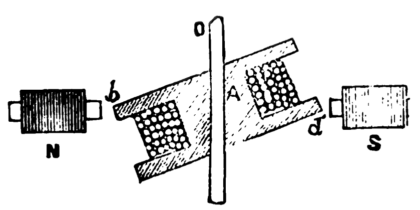

Fig. 6.

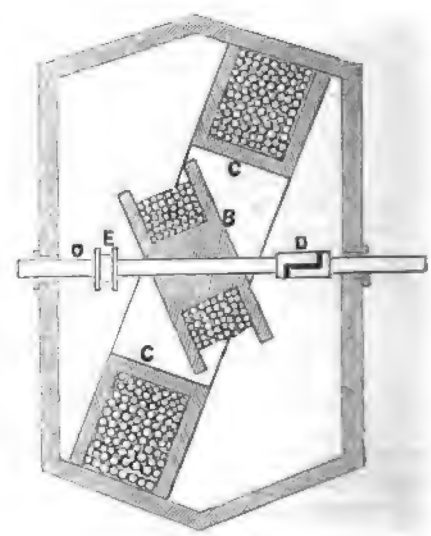

Fig. 8.

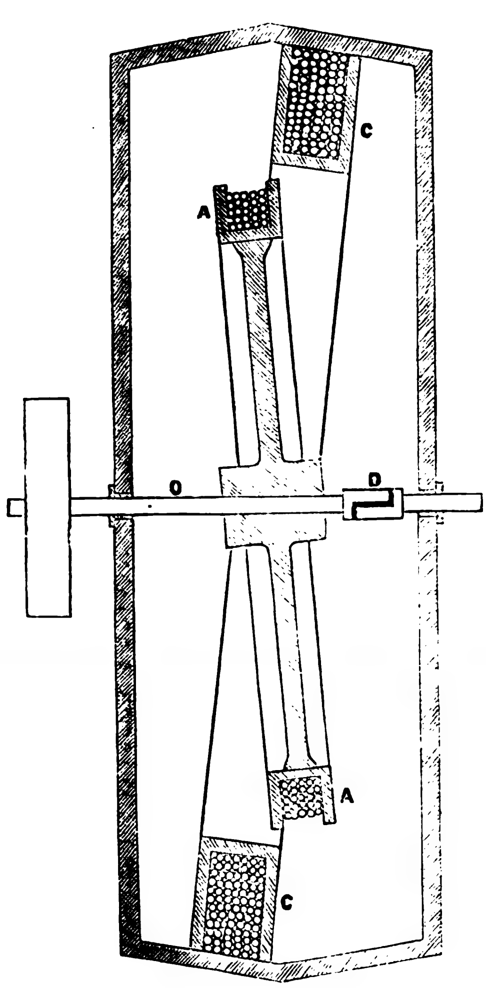

Fig. 9.

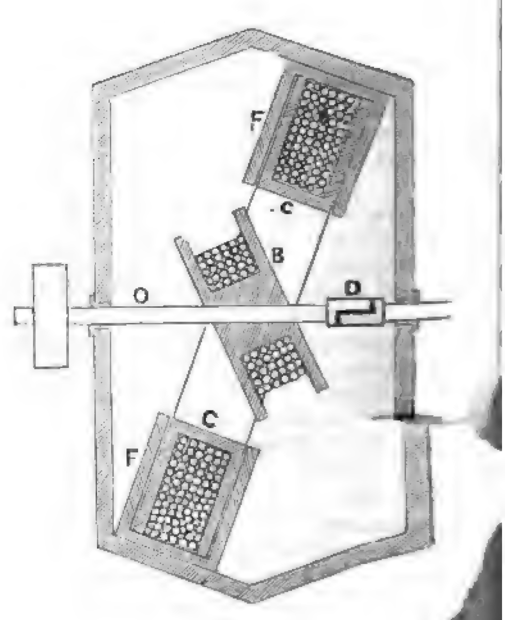

Fig. 7.

continuous and rapid motion of the axis of rotation, with the advantage resulting from the suppression of any magnetic mass in the fixed part.

It will be seen from the diagram of the Jablochkoff motor connections, fig. 5, how it differs from that of M. Bürgin. In the latter a kind of double commutator is employed, and the reversals take place in the fixed outside coil, whilst M. Jablochkoff uses an ordinary reversing commutator and changes the direction of the current in the revolving bobbin.

The Russian engineer's invention, however, relates to the construction and arrangement both of electro-dynamic and dynamo-electric machines in a simple form, or, in other words, his invention may be applied either in electro-dynamic machines—converting electricity into motive-power—or in dynamo-electric machines—converting motive-power into electricity; and the following sketches illustrate some of the various arrangements proposed by the inventor. Fig. 6 is a diagram showing a simple form of machine:—A bobbin, A, having cheeks or flanges, *d b*, of soft iron, and wound with a coil of insulated wire, is fixed obliquely on an axis, O, and revolves between the poles of two electro-magnets, N S. The obliquity of the bobbin is such that, in each revolution, it presents the edges of *d* and *b* alternately to the poles of N and S, and alternating electric currents are set up in the coil of A. Fig. 7 shows a construction in which the bobbin, B, fixed obliquely on the axis, O, revolves within an oblique bobbin, C, which has an iron sheath, F, presenting interior polar edges toward the edges of B. The electric currents generated in the coil of B are collected and converted into currents of the same direction by means of a commutator, D. In the construction shown in fig. 8, the exterior bobbin is of soft iron. The commutator, D, may be applied to alternate the currents in the coil, C, those in the coil, B, being in the same direction, collected in the usual way by rubbers bearing on rings, E. In this case the internal bobbin, B, need not be of soft iron. When the machine is of large diameter, the interior bobbin, A, may be, as shown in fig. 9, merely a ring of iron fixed on a wheel of non-magnetic material. We have purposely omitted putting in the connections in these latter figures, as being unnecessary.

The advantages attached to these machines are several, and, amongst the more important, simplicity of construction takes the first place. The coiling of the wire is perhaps more easily performed than in any other machine, as it is all winding of the most direct character; and the absence also of any nice adjustment constitutes a very important feature. M. Jablochkoff claims as his invention a dynamo-electric or electro-dynamic machine, wherein a magnetic coiled bobbin revolves between or within polar fields, the bobbin being fixed obliquely on its axis, so as to present its opposite edges to opposite fields alternately in each revolution, as described. We have seen the Jablochkoff motor at work in London, but we have no data yet as to its efficiency in comparison with those having magnetic inertia to overcome, and we shall therefore have occasion to return to this matter when the experiments undertaken by the *Maison Breguet*, in Paris, are completed.

GORDON'S ALTERNATING CURRENT MACHINE.

FOR six or eight months past the Telegraph Construction and Maintenance Company's mechanical department has been busily engaged in the manufacture of an enormous dynamo-electric machine, designed and patented by Mr. J. E. H. Gordon, a gentleman well known in the electrical world as the author of a work entitled "A Physical Treatise on Electricity and Magnetism." The machine which we are about to describe is an improvement upon that described in Mr. Gordon's Specification [illegible]8, 1881, both machines being of that class in which a [illegible]r circle of electro-magnets is made to revolve between rings or circles of similar electro-magnets.

[illegible] the machine described in the 1881 Specification the [illegible]ving rings each carry the same number of magnet coils [illegible] fixed rings carry armature coils. The armature coils [illegible]made cylindrical and of the same diameter as the mag[illegible] [illegible]ch being placed close to the next. The inventor found that these coils act on each other by mutual induction in a very injurious manner during the working of the machine, and that if a certain number of lamps are being maintained by one coil, then closing the circuit of the next to it on one side reduces the light of the lamps on the first by some 20 or 30 per cent.—closing the circuit of the next of the other side still further reduces it by a like amount. The reason given is that as the currents in contiguous coils circulate in opposite directions they are in the same direction in those parts of the two coils which are immediately contiguous to each other. As the currents in the two coils are both increasing at the same time they retard each other by their mutual action.

The diagram (fig. 1) will show the action of these coils one upon the other. A, A, are the armature coils, and N, S, S, N, &c., the revolving electro-magnets, and the arrows indicate the direction of the currents.

In the present machine this drawback is got rid of by making the number of armature coils *twice* the number of the magnet coils. The magnets therefore act alternately on the alternate set of coils. For instance, at the instant when the magnets are exerting their maximum action on the alternate coils, 1, 3, 5, and so on, the other alternate coils, 2, 4, 6, &c., are removed from their influence, and therefore are practically idle; 1 and 5 still tend to act injuriously on 3 as before, but being separated from it by the thickness of coils 2 and 4, the inventor finds that their action is so small as to be unnoticeable; 1 and 3 induce electromotive forces in the two sides of 2 respectively, but these are equal and in opposite directions, and so produce no current or change of current in 2.

This arrangement of the coils is shown in diagram, fig. 2, where the same letters correspond to the parts indicated in fig. 1. A general view of the new machine is shown in fig. 3. Mr. Gordon is a firm believer in the general adaptability of the electric light for all purposes, and this dynamo-electric machine—the magnitude of which will scarcely be apparent to the imagination—has been designed to take its place in a large central station for supplying light on a scale comparable with gas.

The revolving wheel, on which the inducing electro-magnets are placed, is built up of wrought-iron boiler-plates, and consists actually of two central discs, and of two cones whose bases fit upon the central discs, and through which the main shaft passes.

The discs and cones are made of segmental pieces of boiler plate, so cut that the grain of the plate is radial to the wheel at the centre of each segment. The segments are riveted together with butt strips, in the way usual in boiler making.

The discs are kept apart at the centre by a cast-iron distance-piece. At the rim they are kept apart by a wrought-iron ring. The cones are of less diameter than the discs, so as to leave a space of flat disc all round exterior to the cones. The cones and disc are separated at the centre by massive cast-iron bosses, turned square to the shaft where they butt against the disc, and conical where they butt against the cones. The cast-iron distance-piece is of somewhat larger diameter than the bosses, so that the discs can be riveted to it without the heads of the rivets interfering with the bosses. The cones, discs, ring, distance-piece, and bosses, are all firmly riveted and bolted together, being still further strengthened by angle-pieces placed between the disc and the cones.

The discs are riveted with double butt strips, the cones with single ones. The butt strips of the cones are placed inside them, and the rivet heads countersunk, so that the outsides of the cones have perfectly smooth surfaces.

The flat outer portion of the wheel receives the magnets.

Each magnet consists of a cylindrical iron core, and of two spools, of brass or other metal other than iron, containing wire, and of two pole-pieces. The core passes right through a hole in the discs and wrought-iron ring, and is fixed so as to project equally on both sides. The brass bobbins are then slipped on one at each side of the disc, and the pole plates being fixed on hold the bobbins in their places. The pole plates are of wrought iron, and their sides are not parallel, but form radii of the magnet wheel.

The shaft runs in bearings of phosphor bronze.

There is a large gap or opening in the sole plate of the machine, through which a portion of the wheel dips into a

pit below. This enables the centre of gravity to be kept low and greatly increases the stability of the machine.

The end thrust is taken by two loose iron collars, placed on the shaft, and pressed gently against the inside ends of the phosphor bronze journals by means of set screws projecting from the ends of the cast-iron bosses. These set screws are secured by lock nuts.

The collars also carry the contact rings for conveying the exciting current to the magnets. The rings are of phosphor bronze, and are separated from the iron collars by split rings of vulcanite or other insulator. Brushes press on them in the ordinary way, to convey the exciting current to them.

The stationary coils, in which the current is produced for the 64 poles facing the magnet-wheel are acted on by 32 magnet poles facing them, the number of stationary coils being twice the number of magnets as before stated.

The details of the fixed coils are shown in figs. 4, 5, 6.

The wedge-shaped core, N, consists of a sheet of boiler-plate bent upon itself so that the angle forms the thin end of the wedge and the free edges, which do not quite meet, form the thick end.

The wedge-shaped head of a T piece, O, is inserted into one end of the folded plate and welded to it, and the stem of the T being turned and screwed is passed through a hole in the fixed ring and is secured by lock nuts, O^1.

The wooden block, P, concerning the use of which we

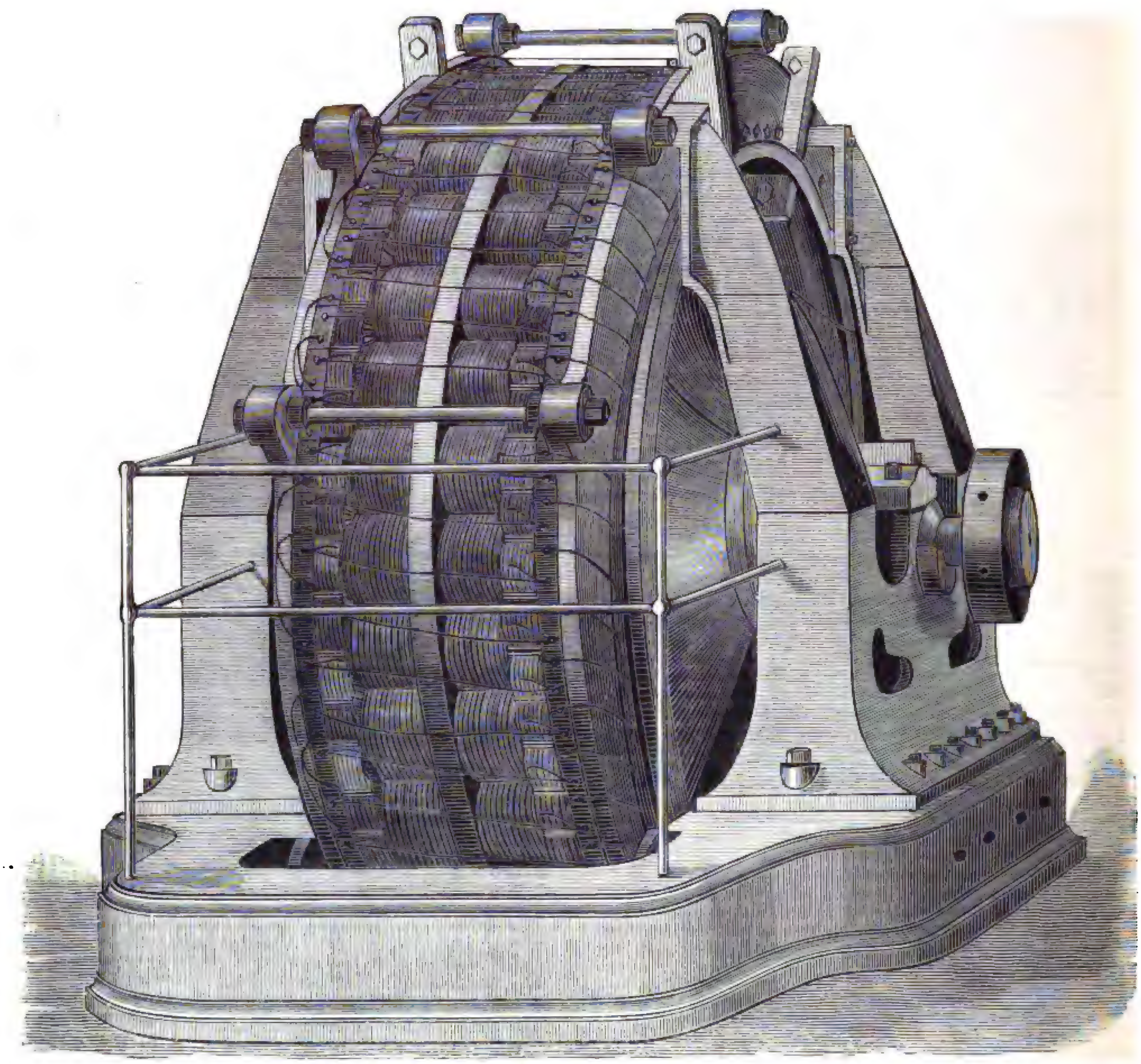

Fig. 3.

the lamps, are attached to fixed rings of cast iron. These rings are supported by being bolted to the inside of the gap in the sole plate and by four cast-iron struts. They are also tied together by seven screwed rods.

Each fixed ring is made in three segments, one being much smaller than either of the other two (the small segment will be seen at the top of the machine). This is for the reason that if one of the magnet coils breaks down it can readily be got at by removing the small segment of one of the fixed rings and turning the wheel until the ·maged coil comes opposite to the gap so produced in the · the damaged coil can thus quickly be removed and ·d by another one.

·ur fixed coils are attached to each ring, so that

shall have more to say hereafter, is slipped on to the core and secured by one or more pins.

The German silver flange, Q, is riveted on to a shoulder cut on the end of the core. In addition to the slots ... are cast in it a cut, Q^1, is made passing completely thro... into the opening of the core. Projecting lugs, Q^2, are ... on the German silver which clip into the opening i... core and prevent the slot, Q^1, from opening. The ... is further secured by being made to project bey... wire in places, Q^3, and being secured to the wood... screws and distance-pieces. These screws must ... be inserted after the wire is wound.

The flanges are thus constructed to check the ... of currents, and German silver is the metal e...

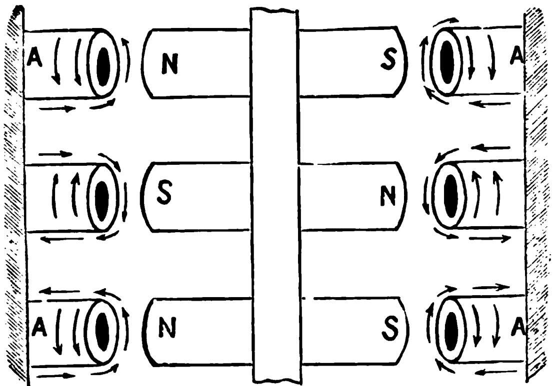

Fig. 1.

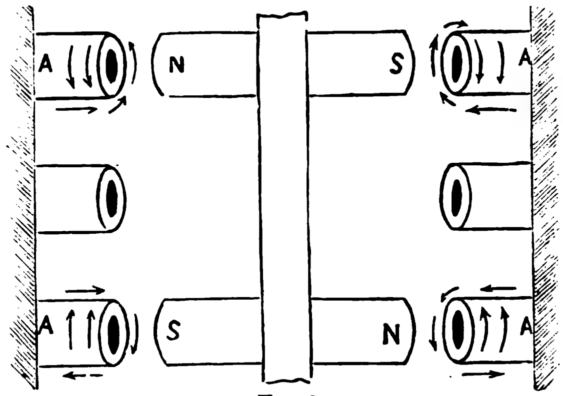

Fig. 2.

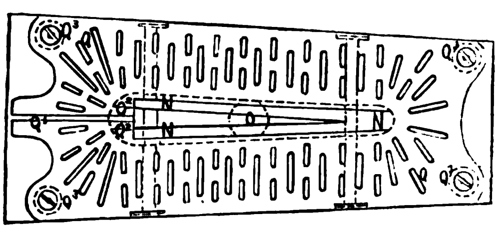

Fig. 4.

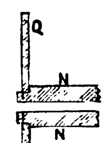

FIG.5

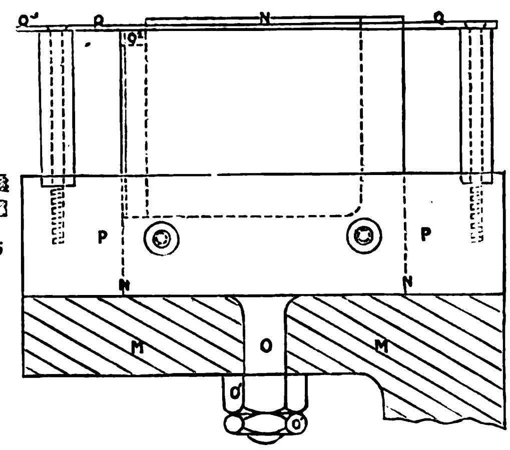

FIG.6.

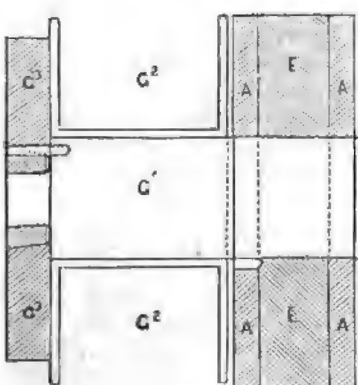

FIG.7

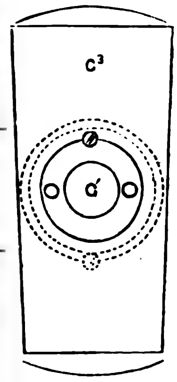

FIG.8

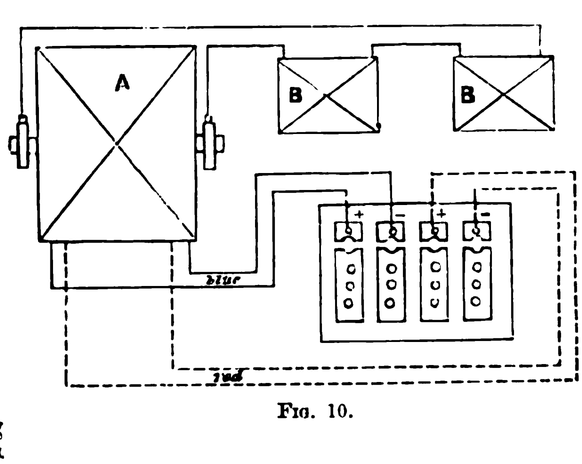

Fig. 10.

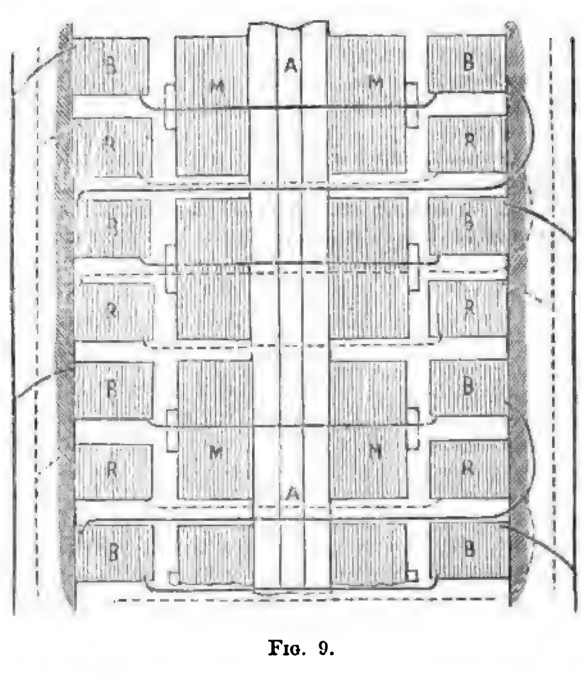

Fig. 9.

this purpose, as it is very rigid and opposes a high resistance to the circulation of currents in it. The use of the wooden block, P, is thus described by the inventor in his specification of December 17th, 1881 :—

"The connection of the outer ends of the cores of the coils on the outer rings I make by prolonging the cores outwards away from the magnet coil and securing them into a fixed iron ring-shaped plate, which forms their support."

"In order that power may not be wasted in inducing currents in this plate it is set back some distance, the cores being correspondingly prolonged. The space between the wire of the coils and the iron plate may be filled up with wooden plates or blocks which form the second flange of the coil, these wooden plates or blocks may be from one inch to three or more inches in thickness."

"This improvement may be applied to any machine where the inducing magnets act on one end of the iron cores of the armatures, whilst the other ends are secured to an iron plate or plates."

The actual distance (3 inches) between the side of the ring-shaped iron plates into which the cores of the stationary coils are screwed and the insulated wire surrounding the core has been mathematically determined by Mr. Gordon; and it is such, that while the coils receive the full benefit of the revolving electro-magnets, the inductive effect on the iron support of the armature coils is reduced almost to zero at any point, and the waste of power in heating, therefore, kept down to a minimum. Were it not for this arrangement the convolutions of wire on the armature coils would either have to be extended beyond the inductive influence of the electro-magnets, thus introducing useless resistance, or the supporting iron plates would be brought within it. Figs. 7 and 8 show the details of electro-magnet construction. G^1 is the cylindrical iron core, G^2 spool, and G^3 the pole-pieces. A and E show a portion of the discs and of the wrought-iron ring to which the electro-magnet cores are secured, so as to project on both sides. The total weight of this machine, which, by the way, is only regarded by Mr. Gordon and his associates as a model for others of enormously increased power, is 18 tons. The revolving electro-magnet wheel itself is of no less a weight than 7 tons, and its diameter is 8 ft. 9 in. The sole-plate of the machine measures 13 ft. 4 in. by 7 ft. Regarding the strength of this huge production of electrical engineering skill, Mr. Gordon informs us that when revolving at 140 revolutions per minute its factor of safety is 200, at 170 revolutions 140, and at 200 revolutions 109 approximately. The capstan, seen on the axle of the machine, is to enable the men in charge to turn it round by hand, should occasion arise.

This machine, now in operation at the works of the Telegraph Construction and Maintenance Company's Works at East Greenwich, is at present lighting only 1,300 Swan lamps of 20 to 22 stated candle-power each, but it is constructed to actuate 5,000 to 7,000 similar lamps with adequate driving power.

The engine now employed and which is coupled direct to the machine is a "picking-up" engine, taken from the company's cable ship *Calabria*, and as may be well understood, it is not particularly suited for this work. The present speed is 140 revolutions per minute, but 200 revolutions will be the speed when the new engines, which will take the place of that now in use, are complete. The connections of the machine are at the moment arranged as follows :—The electro-magnets are all connected up in series, and are excited by the current produced by two Bürgin machines driven by a separate engine, and also connected in series and giving a current in the electro-magnets of 19 ampères.

The armature or "taking off" coils, 128 in number, are connected, four coils in series, and the 32 sets in quantity, so that with 1,300 lamps, arranged two in series, the electromotive force is 105 volts and the current in each armature wire 29½ ampères. All the armature coils are alternately blue and red, and this arrangement is carried out also in the main cables, there being two distinct circuits all over the works. The blue coils are connected to their particular conductor, and the red coils are treated in a similar manner. A sketch of armature coil connections is seen in fig. 9, where A represents the revolving wheel supporting the electro-magnets, M, M. The stationary blue coils are represented at B, and the red by R. The blue and red conductors are shown by the full and dotted line respectively.

Fig. 10 is a diagram representing the large machine, A, the exciter, B, and the switch arrangement, C, to which the current is led and then taken off from the terminals to the necessary points. A very important part of the installation is the photometer room, which might, perhaps, be more justly called the regulating room. The steam-pipes of both engines pass through this room, and in each pipe a stop-valve is placed, each having a large hand wheel connected with it, and under the immediate command of the attendant who watches the photometer screen. These stop-valves may, however, be actuated by a slow screw motion when it is desired to avoid sudden changes in the light, but this can be thrown out of gear instantly so as to allow the valve to be moved rapidly in case of accident. The following instruments are conveniently placed in this room so as to be under the observation of the man in charge: A steam gauge to indicate the boiler pressure, and a speed indicator to show at any moment the speed of the large dynamo. An ammeter of the Ayrton and Perry form is employed to show the exciting current, and the armature of the ammeter magnet is attached to a cover over the dial, so that when an observation is taken the armature must necessarily be taken off before the pointer can be seen. A short-circuiting key has also been attached to its terminals, kept closed when one is not actually taking an observation. An ordinary "shadow" photometer is arranged with a "Sugg's" standard candle, to compare with either a lamp belonging to the blue circuit or one from the red. These may be switched on or off when requisite, and they are attached to points on the circuit at a distance fairly representing that which might be selected as a test lamp in actual lighting operations on a large scale. The standard of illumination at which these indicating lamps are kept is as nearly as possible 22 candles. If there happened to be any great difference between the number of lamps on the red and blue circuits—no such difference will occur in practice, however, if the same class of house be put in each circuit—switches are provided by which street or other lamps near to the machine can be instantly transferred from one circuit to the other, 50 or 100 at a time, if a fine adjustment of the circuits is required.

Additional work being put upon the machine is shown immediately to the attendant by the decrease of speed and the diminution of candle-power in the indicating lamps, and is at once met by giving more steam to the engine. The method of starting is as follows :—The large machine is driven up to its normal speed unmagnetised, then the exciting "Bürgins" are slowly revolved, and the current produced by them circulating in the electro-magnets of the large machine reduces its speed. It is again driven up to 140 revolutions per minute, and the speed of the exciting machines still further increased, which again reduces that of the large machine. These operations are continued in this gradual manner until the lamps attain their normal candle-power, and the time taken up in attaining the desired result is usually about twenty minutes. The 1,300 lamps now in use are distributed over every part of the Telegraph Construction and Maintenance Company's Works, covering fourteen acres of ground, and it gives one a fair idea of the lighting by electricity of a small town. The lamps are arranged in the ordinary method, only instead of there being but single lamps between the conductors there are two, or in other words, they are arranged two in series. Some tests of Swan lamps were recently made by Mr. Willoughby Smith and his assistant, Mr. Perkins, at the Wharf Road Works, of the Telegraph Construction and Maintenance Company. It was desired to ascertain the electrical horse-power given to the lamps when at a luminosity of 19, 20, and 21 candles. The following table gives the results of these measurements :—

SWAN LAMPS TESTED AT WHARF ROAD, OCTOBER 10TH, 1882.

Number of Lamp.	Candle-power to be.	Current through lamp in ampères.	Difference of potential at lamp. Volts.	Energy expended in lamp horse-power.	Number of candles per electrical horse-power.
1	19	1·36	51	·093	204
1	20	1·41	52	·098	204
1	21	1·44	52	·100	210
2	19	1·31	52	·091	208
2	20	1·36	53	·096	201
2	21	1·41	53	·100	210

Indicator diagrams taken by the company's chief engineer and compared with the calculated electrical horse-power

show apparently that 94 per cent., and even more, of the indicated horse-power is reproduced in the lamps. We do not intend, however, entering into this question at present, although it is obvious that an error has crept in; this may possibly be Mr. Gordon's assumption on the strength of the foregoing tests, and the observations in his photometer room, that in every lamp one-tenth of a horse-power is expended.

A few additional items regarding the machine may interest our readers. The stationary and revolving coils are wound with No. 7 B.W.G. copper wire, and the resistance of the latter is 8 ohms, the coils being all joined up in series to suit the exciters. The resistance of each stationary bobbin is ·06 ohms, and the total resistance as the coils are at present joined up is roughly ·008 ohms. The weight of wire on each electro-magnet bobbin is 46 lbs., and that of each stationary coil 19 lbs. When Mr. Gordon has more engine-power at command and a larger number of lamps are employed the 128 fixed coils will be all connected up in quantity, and their resistance will then be only ·00047 ohms.

The electromotive force of the machine will be about 60 volts, and Swan lamps of a different resistance will then be used between the conductors singly, and not two in series as now.

It is intended that the machine when in full work with, say, 5,000 lamps, shall have an engine at each end. As it has been suggested that alternating currents passing in the streets would disturb telegraphic communication, the experiment has been made of lighting the cable tanks and test-rooms by means of it. The electricians report that no disturbance in the testing has been caused. This experiment, however, proves nothing, since the Thomson galvanometers used for testing purposes, although highly sensitive, are very sluggish in their action, and rapid alternating currents would not affect them; but these currents would powerfully affect a telephonic circuit, and, moreover, be quite capable of setting in vibration the tongue of a moderately sensitive polarised relay.

On Wednesday evening last, a number of gentlemen, at the invitation of Mr. Gordon and by permission of the Telegraph Construction and Maintenance Company, visited Greenwich for the purpose of inspecting the installation. They were afterwards entertained at dinner, and Sir James Anderson, in proposing Mr. Gordon's health, remarked that after having seen the machine he considered it a complete success. Mr. Gordon, in the course of his reply, dwelt on the necessity of having large central stations similar to our present gasworks, with large dynamos going at a very slow speed. They could then afford to pay a considerable sum for supervision when a large number of lamps were employed. He would like to see a much larger machine than his present one, and thought he would get great economy by having a revolving ring of 18 feet diameter, and turning at 60 revolutions per minute. Mr. Swan said he was pleased with what he had seen, and pointed to the close approach of the time when domestic electric lighting would become general. He thought the machine a grand success, and several other gentlemen also spoke on the subject in like terms.

The trial may be said to have been very satisfactory, and the effect of the Swan lamps in the various departments of the cable factory was extremely fine. Outside the buildings, however, the candle-power of the lamps seemed to vary to a considerable degree, and in many instances our surmise that one-tenth of a horse-power was not being expended in each lamp appeared confirmed. However, it is hardly within our province to criticise at present an exhibition which is little more than an experiment and concerning which we have no actual data removed from the possibilities of error. We congratulate Mr. Gordon on a success which promises well for the future of electric lighting by incandescence, and we shall follow with great interest further experiments with this, the most powerful and mechanically the best constructed machine yet seen. We may add that every facility and assistance has been afforded Mr. Gordon during the course of his labours by the Telegraph Construction and Maintenance Company.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

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CORRESPONDENCE.

THE *TIMES* AND THE "FERRANTI" MACHINE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Dr. Lardner's dictum that no steam-ship could be built big enough to carry sufficient coals for a voyage across the Atlantic has become quite proverbial to indicate the failure to which learned as well as unlearned men are liable in prejudging the development of technical industry and the application of scientific principles. As another example of which you give in your impression of last week the opinion expressed in 1874 about the Gramme machine when introduced into England by Werdermann.

You very properly advise your readers with reference to the Ferranti dynamo machine, not "to put too much faith in any extravagant assertions which may have been spread abroad concerning the efficiency of the new dynamo;" and you propose to reserve your definite opinion on the machine until "we have had the opportunity of seeing and examining it." Quite so! Although you state that you "can safely say that the invention is something more than a modification in minor details," you express yourself in guarded language.

Now I maintain, Sirs, that we are not in the same position as Dr. Lardner was when he judged his big ship. We have built dynamos of every conceivable form, and are fully conversant with the principles which govern their action, know how to measure their efficiency, and we know that simply the question of supply and demand, besides monopoly, determines their cost.

But however enlightened your readers may be on this subject, thanks greatly to the information contained in your columns, how about the general public? Will the every-day reader of the daily paper—say, the educated reader of the *Times*—be in a position to judge between "essential differences" and "modifications in minor details?" Will this educated reader know how far to accept as correct the statement (as contained in the *Times* money article of September 22nd), that this new wonderful machine, the joint or simultaneous invention of Sir William Thomson and Mr. Ferranti, "can be manufactured for one-fifth the cost of the cheapest dynamo at present before the public" because "the great feature in the new machine is th-

absence of iron in the revolving armature" (*sic*) and "the increased efficiency is aided by the absence of the commutator?" Perhaps the educated "investing" reader possesses shares in one or the other of the Electric Light and Power Companies, and not being an "Electrical Scientist," will rush to his stockbroker to part with his shares, since he may be of the same opinion as Mr. Pertwee, who, at the end of his remarkable letter in the money article of the *Times* of October 2nd says, with regard to the efficiency of the Ferranti machine . . . "the new patents" . . . "will, *if expectations be realised*, virtually have the effect of setting aside completely the present property."

Your space is too valuable to reprint the whole paragraph contained in the money article of the *Times* of September 22nd, but I would advise you and your readers to peruse the same; to learn how far "Jupiter of Printing House Square" can raise the wind on a scientific question, or to speak plainer, on a proposed industrial undertaking. The information conveyed in the paragraph is qualified by such expressions as "*we understand*"—"*it is stated*"—"*we are informed*," whilst the prospective picture drawn of this machine is based on two scientific principles well known to, and practically applied by, electricians for some years now.

You and your readers will, I doubt not, agree with me, that in the face of the fact that little or nothing is known of or about the Ferranti machine, such language in the *Times*, as coming from its editor, is not only *misleading* but highly *injudicious*—nay, *reprehensible*.

We all believe in the improvement and simplification of the dynamo machine, but to advance unqualified statements on hearsay—on questions, too, about which the general reader is not competent to judge—savours of a proceeding which we should think has been played out in the late "Electric Light Bubble."

I have no endeavour to decide either for or against the Ferranti machine, but simply wish to protest against *public opinion being influenced by a leading paper on a financial question relating to an* UNTRIED INVENTION, and I believe I shall be supported by every right-minded man.

Yours faithfully,
MORE LIGHT.

[At one moment our correspondent speaks of the paragraph in question as being qualified, and shortly afterwards to its being unqualified. This is at least somewhat contradictory.—Eds. Elec. Rev.]

ELECTRIC LIGHTING.

To the Editors of The Electrical Review.

Sirs,—In addition to the discussions on the merits of rival dynamo machines and lamps, the public is likely to be further distracted by the claims of patentees to the sole right of doing everything in connection with electric lighting.

Mr. Edison disputes the right of any one to use incandescent lamps other than those covered by his patents, and now Mr. Lane-Fox claims the privilege of lighting by a plan combining the use of dynamo machines, secondary batteries, and incandescent lamps in multiple arc.

This company gives to the world a better method of doing the same thing by secondary batteries, *in series*, and lamps from these series in multiple arc.

All these claims and differences among the doctors will probably cause Town Councils and other local authorities to pause before embarking upon the business of electric lighting under Board of Trade licences or Provisional Orders, and leave the development of the enterprise in the hands of the various patentees and their concessionaires.

Yours faithfully,
GEO. OFFOR,
Manager, the South-Eastern (Brush) Electric Light and Power Company (Limited).

London, *October 21st*, 1882.

LANCASHIRE AND CHESHIRE TELEPHONIC EXCHANGE COMPANY (LIMITED).

To the Editors of The Electrical Review.

Gentlemen,—With reference to the article in your issue 'nst. on this company and the trunk rates between

These are not, as you suppose, fixed by us but by the Postmaster-General, who runs the wires and receives the whole of the moneys accruing, less £5 per subscriber, which he returns to us for terminal charges.

Needless to say this rebate is not sufficient to cover current expenses in connection with the manipulating of the wires, and instead of being gainers, we are losers by the transaction.

From the above you will readily understand that, the rates not being fixed by us, we are powerless to make any alteration in them.

Yours faithfully,
KENNETH MAC IVER, *Secretary*.

Manchester, *October 25th*, 1882.

NOTES.

Notice to Readers.—Subscribers are hereby notified that in future the supply of back numbers of the Electrical Review cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

The Use of Lead in Accumulators.—At the meeting of the United Van Consols Lead Mining Company, on Tuesday last, allusion was made to the demand for lead by electric companies for their accumulators and other apparatus as being likely to tend towards raising the price of lead ore from £9 to its normal price of £14 per ton.

Observations on Earth Currents.—By Dr. O. Frölich.—At the request of the Committee on Earth Currents appointed by the Electro-technical Association, the firm of Siemens and Halske have modified their so-called "soot-writer" (Russ-schreiber), so as to register earth currents continually. For a trial of this apparatus one of the wires from Berlin to Dresden was placed for a time at the disposal of the committee, and some interesting results were obtained.

The apparatus consists essentially of a current-disc moving in a constant magnetic field. Its movements are registered by a pointer upon a slip of paper blackened over with soot and drawn slowly forward by clock-work. The zero line is indicated constantly by a separate index. The ordinates of the curves drawn upon the paper are proportional to the currents prevailing at the time. The movement of the paper is regular and amounts to 117 millimetres hourly. The wire was sunk in the earth at Dresden and was connected with the earth at Berlin by means of the soot-writer. A Daniell element introduced into the circuit, gave a deviation of about five millimetres at the soot-writer. The author figures the curves obtained on the evening of July 22nd from 7.30 to 9.30 p.m., and on July 25th from 5.45 to 7.45. On the first occasion the weather was sultry, with some rain; on the second there was a strong thunderstorm with frequent flashes of lightning. On both occasions the current-curve showed a tolerably uniform course, accompanied by sudden convulsive deviations. If we neglect these, we find in the curves prolonged periods in which the index made continually a track of a certain width in the soot, being in constant movement. This is evidently due to the induction-strokes produced by telegraphing in the neighbouring wires of the cable. These inductions, especially if the Hughes' apparatus is employed, are of equal strength and compensate each other, so that the course of the curve is not disturbed and the middle of the broad track represents the value of the real earth-current.

Of the sudden deviations in periods when no des[illegible] are being sent, some, though but few, are due to te[illegible] attention signals. No regular periods of the ear[illegible] could be recognised in the curves obtained eith[illegible] days or on others. The curve obtained during t[illegible]

storm is of especial interest. The course of the curve of the earth current did not differ essentially from that obtained on the former occasions. Very conspicuous are the numerous and in part very powerful induction strokes in which the course of the storm may be traced. These induction strokes coincide with atmospheric discharges, for in a number of cases where the time was noted, the official watching the apparatus observed lightning simultaneously. The deviations in the curve of July 22nd may be due to fainter or more remote atmospheric discharges.

The chief result of these observations seems to be that during a thunderstorm the character and the strength of the earth-current are not essentially changed, and that the whole influence of the storm is expressed in induction strokes, which are due to atmospheric discharges.—*Electrotechnisch Zeitschrift.*

THE BEHAVIOUR OF SULPHATE OF LEAD IN A SECONDARY BATTERY.—Professor O. Lodge communicates the following information to our contemporary *Nature*:—"Since the meeting of the British Association at Southampton I have made several experiments on the action of sulphate of lead at the negative pole of a decomposition cell, with a view to ascertain, not whether the sulphate was reduced in bulk by the action of the nascent hydrogen, a matter concerning which I had satisfied myself before in the negative, but the less practically important matter whether any *trace* of metallic lead could be obtained upon the negative plate by this action.

"I used, therefore, platinum electrodes, immersing them in a paste of sulphate of lead in dilute sulphuric acid. And at the suggestion of Prof. McLeod, in order to obtain sulphate pure and in a fine state of subdivision, I precipitated a quantity from dissolved carbonate.

"The paste soon settled down, leaving about a quarter of an inch of clear liquid above it, which was decanted off. Small thick platinum plates stood in the paste about two inches apart, and were connected with either three or two Leclanché cells. When three cells were used, the evolution of gas from both plates speedily scooped out a hole round each filled with only turbid liquid, which was kept agitated by the bubbles.

"Under these circumstances a distinct darkening of both plates occurred, and after a day or two they showed a distinct, though extremely thin, coating of peroxide and of metallic lead respectively. Prof. McLeod had tried the same kind of experiment, and noticed that the darkening occurred more readily on portions of the plate in contact only with free liquid than on those imbedded in paste.

"I therefore re-embedded my plates, and employed only two cells to charge them, so that the bubbles might not have power enough to remove the paste from contact with the plates at all parts; under these circumstances the growth of peroxide of lead at the + plate was abundant, so much so that when the plate was ultimately pulled out, it left a black mass behind it, which had penetrated into the white paste; but the growth of the metallic lead on the — plate was even less perceptible than before, and it was evident that the metallic lead was better deposited from the solution than from the paste. It seemed probable, therefore, that though the sulphate is extremely insoluble in dilute acid, yet that a sufficient trace was dissolved to be acted on by the hydrogen, and that as fast as this was decomposed more was dissolved from the large quantity of solid present, provided the liquid was free to circulate and become replenished.

"To test this further, I first made a saturated solution of sulphate of lead in the acid, by shaking and stirring it up with the finely divided precipitate for many hours—though ordinary dilute sulphuric acid is probably perfectly saturated without any such treatment—and then electrolysed the clear solution. No effect is ordinarily perceived under these circumstances, and I could perceive none. Hence the quantity dissolved at one time must be something infinitesimal; and it is able to give no appreciable deposit, unless fresh solid is present to replenish it.

"Next I took a vessel full of the sulphate paste, but with a third of an inch clear liquid standing above it; and into this clear liquid I dipped the platinum plates, barely letting them touch the pasty mass below. In this position they remained several days connected to two Leclanchés, and the result was a distinct blackening of the — plate with a deposit of metallic lead from the solution; but the + plate scarcely seemed to receive any deposit of peroxide except along its bottom edge, which probably just touched the paste, and which showed a narrow line of deep puce colour. The observation that the — plate received its deposit more easily from the free solution than from the paste, had been previously made by Prof. McLeod. But to get the deposit most quickly, it is best to immerse the plates in the paste, and to cause sufficient gas to be evolved to keep them free from actual contact with it; while at the same time the solution surrounding them is so near a large surface of paste, that it can be very rapidly replenished.

"On neutralising the acid with ammonia, so that ammoniacal salts and common salt might be present, in which sulphate of lead is known to be somewhat soluble, the deposit of metallic lead went on with far greater rapidity.

"I have subsequently repeated the experiments with a paste of ordinary sulphate of lead, and the results appear to be quite the same. A week's deposit could be dissolved off the negative platinum plate with a single drop of nitric acid, and could only be made to show a faint precipitate when sulphuric acid was added to this solution in a watch-glass.

"Moreover, unless the plate were rinsed on extracting it from the paste, the small amount of sulphuric acid clinging to it was sufficient to so whiten the deposit in the course of a night as to make it seem almost as if it had disappeared.

"The matter is rather a small one to write so much about, but the behaviour of sulphate of lead in secondary batteries is really of considerable importance, and is at the bottom of a great many of the difficulties which one meets with in practical operations with secondary lead cells.

"Moreover, it is only due to Dr. Gladstone that I should say how far I have been able to obtain his results; and he will perceive that if all he asserts is that platinum electrodes do show a nearly infinitesimal tarnish of metallic lead (as I understood him to say at Southampton), then my experience agrees with his. But I think that this is merely due to the partial solubility of the sulphate; and I never find that the reduction is able to spread through the paste in the slightest degree, in such a way as to have any practical bearing on the behaviour of a secondary battery."

GAS V. ELECTRICITY.—Brampton is again lit with gas, says the *Derbyshire Courier*, and judging from the report of the proceedings of the Local Board, published in your columns last week, the members think they have made a splendid bargain with the gas company. The terms are to light the 50 lamps in the district from half an hour after sunset to midnight for six months for the sum of £100. The lamps are not be lit on moonlight nights, and the hours so saved are to be put on after twelve o'clock on very dark nights. Some time ago when the board asked the company to make an arrangement of this kind it was haughtily refused, and I only mention it now as indicating some little improvement in the disposition of the directors to meet the wants of their customers. But the terms! In the six months the lamps will be lit 1,200 hours, and the cost for 50 lamps will be £100. In Chesterfield the lamps were lit nearly 4,000 hours, and the cost for 200 lamps was £930. In other words, Brampton is paying *at the rate of* between £1,300 and £1,400 for what Chesterfield got for £930! It has been said that the tenders of the Electric Lighting Company were unsuccessful both at Newbold and Brampton, "mainly on account of the price." This is totally incorrect. The tender at Newbold was exactly the same as that of the Gas Company, viz., £200 for 63 lamps for six months—the period asked for; but the Gas Company offered to light an additional month for an extra £10. Probably the Electric Lighting Company would have done the same, but it does not appear that they were asked. With regard to Brampton the error is still more flagrant, for there the Electric Lighting Company agreed to light the 50 lamps *all night* for six months for £100, the sum that is being paid to the Gas Company for lighting them up to *midnight!* Our friend Mr. C. E. Jones has placed on record his opinion that a gas-lamp is as good as a policeman; consequently at Brampton there will be just 50 "policemen" deficient after twelve o'clock, which is generally understood to be the time

when "the enterprising burglar" does his "burgling!" Why did he not persuade the Local Board to have the lamps lit the whole night? But in that case how would the cost have compared with that of the electric light?

The Electric Light on Ships.—The Admiralty have decided to light the troop ship *Himalaya* throughout with the electric light. The lamps to be used are the Swan incandescent. The dynamo machines are of the Siemens type, driven by the Brotherhood engines.

Electric Lighting.—A special meeting of the Dundas Gas Commissioners was held last week for the purpose of considering the advisability of applying for a Provisional Order to supply electric light to the town. A report by the gas manager on the subject was read. It stated that the works necessary for supplying the electric light to the town would consist of two centres of supply—one at the gas works and one in Ward Road. The size of the engines required would, of course, depend upon the demand for the light. A very convenient form, the dynamo machine, might be had, which would supply 40 arc lights, and to drive this machine would need an engine of from 40 to 50 horse-power nominal. This, to begin with, would be sufficiently extensive. He considered that a fair maximum price would be 1s. per hour for the arc light, and 4d. per hour for the incandescent lights. For the safety of consumers and the public, he recommended that all wires in the principal streets should be laid underground and encased in tubes. The commissioners, after full consideration of the matter, unanimously resolved to apply to the Board of Trade for a Provisional Order to supply electric light to the town.

A local contemporary says:—"It seems that there is an immediate prospect of the manufacture of electric lighting apparatus taking practical shape in Glasgow. The great drawback to its general use hitherto has been the expense of the necessary appliances and the motive-power, but if electric generators, motors, and lamps can be manufactured as cheaply and expeditiously as the Universal Electric Company undertake to do, there can be little doubt that for public works and street lighting at least, the electric light will become pretty general."

The Hamilton Town Council, at a special meeting on Thursday week, adopted the recommendation of their committee, "That application be made by the burgh for a Provisional Order as being the best policy in the present circumstances."

The Glasgow Corporation have decided to apply for powers to supply electric light for public and private purposes within their burgh.

The *Dundee Advertiser*, of Saturday last, says:—"Favourable opinions were expressed by the large number of visitors to the exhibition regarding the purity and coolness of the air in the galleries. The preservation of the purity of the colours of the pictures, as well as the purity of the air, is also a noticeable improvement due to the electric light, and was specially observed in deliciously warm colouring in the fine work by Phil. Morris, A.R.A., 'The Gipsy,' recently presented to the town by Mr. Orchar."

In the "Third Notice" of the works exhibited, the reviewer in the same paper, says:—"Those stolid conservatives, who feel it to be their chief end and mission to oppose everything which savours of innovation, have been loud in their prophecies of the failure of electric illumination. Especially was their contempt vented upon the deluded enthusiasts who dreamed of utilising the new light in picture galleries; and it was confidently asserted that the perfect colour transformations which the light from common gas caused would be greatly multiplied with the increased brilliancy of the electric light. But one evening visit to the Exhibition in the Albert Institute will be sufficient to dispel this illusion. It will be found that the delicate greens and blues, whose so altered appearances under gas-light horrified the very artists themselves, retain their pristine effect under the mildly diffused electric light; it adds to their intensity, without depreciating their value. Especially is this noticeable in the Second, Third, and Fourth Galleries, where the [illegible] light is so defective that many of the pictures can only be properly seen by the aid of this artificial illumination. These are points which artists will most readily appreciate, while the ordinary visitor will not be ungrateful when he finds that he can have better light than gas can afford, without losing the oxygen which nature intended for him, and which the gas consumes to his discomfort."

At the meeting of the Glasgow Corporation, on Monday last, the clerk read a letter from the Brush Electric Light and Power Company of Scotland, offering to place a number of their arc lamps in any thoroughfare the Council may decide on, so as to show what their system is capable of doing, on being paid the cost of gas consumed in the locality in which they are installed. The letter was remitted to a committee for report.

The Watching and Lighting Committee's recommendation that the application from the Universal Electric Company, for permission to fix an electric arc lamp on the top of the clock, on the "Shetter," at Bridgeton Cross, the company fitting up and lighting the same free of charge, was agreed to.

In the neighbourhood of the Thuringian town of Kosen there are some disused saltworks, with considerable water-power. The latter is now to be utilised for the electric lighting of the town, and Kosen will thus be the first German town to introduce the electric light for illuminating the whole town.

Mr. Duncan and Mr. Hardy, both of Union Street, Aberdeen, have been trying the electric light for the illumination of their shops. The experiments have been most satisfactory, and these gentlemen have determined to replace the gas by the electric light.

The following alterations have been made in the rules issued by the Board of Trade in August last:—Rule 5, the words "The lands which the applicants propose to take for the purposes of licence or order" have been omitted. Rule 9, the wording of the first few lines of this rule has been altered to make the meaning more clear.

The City of London Commissioners of Sewers have decided to become the undertakers for the supply of electricity, and to apply to the Board of Trade for licence accordingly.

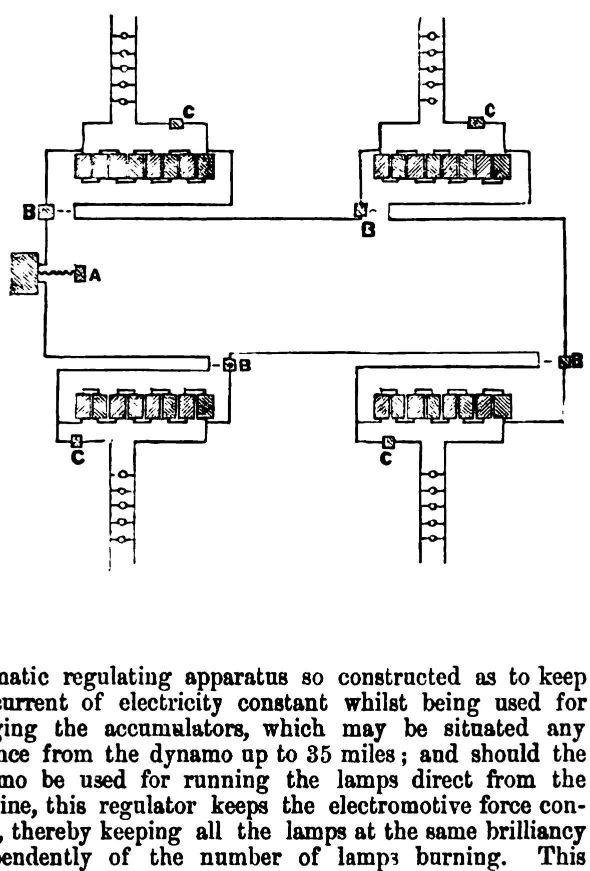
We understand that Mr. Conrad Cooke, whom we mentioned last week in connection with the Sheffield electric lighting, now holds a similar position in regard to Reading.

Electric Light Companies.—Under this heading the *Financier* writes:—"It is a pity, in the interests of the shareholders and of the public generally, that the various electric light companies should apparently be drifting into litigation, as the effect can only be that their progress will be paralysed and the shareholders' money wasted. Surely some arrangements could be come to for the good of all without so much rushing into print, and so much mutual defiance of presumed antagonists and infringers. The effect of the warfare is simply that the public are prevented from adopting as readily as they otherwise would do this really useful and beautiful light. That there is plenty of room for all is one of the most patent facts. Why then so much quarrelling?"

Electrical Education.—We hear that the demand for tickets by students wishing to work in the electrical laboratory, under Professor Ayrton, at the City and Guilds of London College, has now become so great that until the larger rooms at the new Finsbury College are ready, it has become a question whether any more tickets can be sold, since the 300 students now attending the electrical courses are even more than the present laboratories will accommodate. It is gratifying to find that this opportunity, offered by our city companies to workmen to obtain sound, cheap, technical education, has been so largely taken advantage of. Men in the employ of every metropolitan electric lighting company may be found among the students at the Finsbury College, and in some cases the students come regularly a distance of thirty miles, being employed during the day in the country. Some of the employers have shown the value they attach to their men being technically educated by paying themselves the college fees.

ELECTRIC TRICYCLES.—Last week the passers by were astonished at seeing a tricycle electrically lighted and electrically propelled going down Queen Victoria Street. The source of the electric current was a few Faure's accumulators resting on the footboard, the electric lamps, of which there was one on each side of the tricycle, were incandescent lamps, giving each about four candles, and the electro-motor was one of those recently devised by Profs. Ayrton and Perry, and was fastened under the seat which was occupied by one of the inventors. One speciality of these motors is their compactness and the large amount of power they can furnish for their weight, the total weight of the quarter-horse-power-motors, with the Faure's accumulators necessary to propel the tricycle with its rider at the ordinary speed, as well as to electrically light it, being only, we understand, about $1\frac{1}{2}$ cwt., or but little more than that of a second rider.

THE "B. T. K." SYSTEM OF ELECTRIC DISTRIBUTION.—We have been presented with a copy of the circular issued to the shareholders of the South Eastern and Provincial (Brush) Electric Light and Power Companies, Limited, and also a block plan and general description of the mode of the "B. T. K." system of electric distribution invented and perfected by the electricians to these companies. It has not been patented, as they considered that the electric light in general should not be hampered by such means. Referring to the block plan, A shows the position of the



automatic regulating apparatus so constructed as to keep the current of electricity constant whilst being used for charging the accumulators, which may be situated any distance from the dynamo up to 35 miles; and should the dynamo be used for running the lamps direct from the machine, this regulator keeps the electromotive force constant, thereby keeping all the lamps at the same brilliancy independently of the number of lamps burning. This apparatus enables engines to be utilised that could not be employed under any other system, as it counteracts the effects of variations in their speed. By a peculiar automatic apparatus situated at B, only the proper quantity of current is allowed to enter the accumulator to supply the amount used since the previous charge; this apparatus is also a meter for registering the quantity of current supplied.

At C is an automatic contrivance for keeping the electromotive force constant whatever number of lamps may be turned on or off inside the dwelling-house in which the accumulator may be fixed.

It will be noticed that the system is that of charging the accumulators *in series*, and it will be understood from the previous description that as any accumulator becomes charged the apparatus B cuts this accumulator out of the series until some of the current has been used, when it brings the accumulator into the circuit again. It will also be seen from the diagram that the lamps are worked direct from the accumulators in multiple arc, and the apparatus, C, keeps the electromotive force of current passing to the lamps constant, through proportioning the resistance of the external to that of the internal resistance of the accumulator. These are the principal points of the system, but it also comprises many other minor apparatus.

INTERNATIONAL PROTECTION TO OCEAN CABLES.—"To the Editor of the *Evening Post*:—Sir,—I beg to enclose you an extract from the London *Times*, published in the New York papers of this morning, suggesting that the United States Government must protect submarine cables by international treaties as follows:—

"The *Times* this morning, in an editorial expressing satisfaction at the completion of telegraphic communication between the United States and South America, refers to the question of defending cables and says, 'the United States cannot too soon acknowledge the necessity for shielding submarine telegraph lines by international sanctions, and must find means for applying them.'

"This is a question that has failed to secure any definite action on the part of foreign Governments up to this time.

"I enclose herewith a recent correspondence with the Navy Department of the United States Government on this subject. Also the instructions of the Hon. Wm. H. Hunt, Secretary of the Navy, to Rear-Admiral George B. Balch, commanding United States naval force, Pacific Station, and a further correspondence between the Hon. Wm. Henry Trescott and his Excellency Senor Balmaceda, Minister of Foreign Affairs, Republic of Chili. You will observe that the spirit of this correspondence clearly indicates that submarine cables in the free seas, the property of American citizens, will receive the same protection as our national flag on the high seas.

"I will here add that the contracts between the various Governments, on whose shores the cables of this company are laid, secure to this company the international protection deemed so necessary by the London *Times*, and which up to the present time most other foreign cables have failed to secure.

Respectfully,
"JAMES A. SCRYMSER,
President Central and South American Telegraph Company.
"New York,
"*October* 11th, 1882."

[The correspondence referred to by Mr. Scrymser appears to sustain the view which he takes—viz., that our Government will protect the cable on the high seas adjacent to the South American coast against interference, and that the Government of Chili, now administering the affairs of Peru, will consent thereto.—ED. *Evening Post.*]

WESTERN UNION TELEGRAPH COMPANY'S ELECTION.—At a meeting of the Western Union Telegraph Company, to-day, at which more than 650,000 shares were voted upon, the following Board of Directors was elected:—Norvin Green, Thomas T. Eckert, Edwin D. Morgan, John Van Horne, Augustus Schell, Harrison Durkee, Jay Gould, Russell Sage, Alonzo B. Cornell, Sidney Dillon, Cyrus W. Field, John Pender, M.P., Henry Weaver, Percy R. Pyne, Robert Lenox Kennedy, Hugh J. Jewett, J. Pierpont Morgan, Frederick L. Ames, Edwin D. Worcester, William D. Bishop, C. P. Huntington, George B. Roberts, Zalmon G. Simmons, Samuel Sloan, Erastus Wiman, Amasa Stone, George J. Gould, Chauncey M. Depew, James W. Clendenin, George T. Baker.

The new directors will meet to-morrow and elect officers. The annual report was submitted, and shows that the capital stock of the company is 80,000,000 dols., of which 20,172·50 dols. belongs to and is in the treasury of the company. A small portion of the capital stock is still represented by certificates of indebtedness in the hands of the Union Trust Company, in trust for the parties entitled thereto. The bonded debt at the close of the year was as follows:—

	Dollars.
Bonds due March 1, 1900—6 per cent.	941,382·00
Bonds due March 1, 1900—7 per cent.	3,920,000·00
Bonds due March 1, 1902—7 per cent.	1,373,000·00
	6,234,382·00
Less balance of sinking funds appropriations not yet used for redemption of bonds, held by the Union Trust Company trustees ...	225,191·24
Total	6,009,190·76

Two thousand pounds in sterling bonds, due March 1st,

1900, were redeemed by the trustees of the sinking fund, July 1, 1881, showing a surplus of 127,258·76 dols. Profits increased it to 7,118,070 dols., from which there was applied for dividends, interest on bonds, and sinking fund appropriation, 5,265,662·73 dols., leaving a balance of 1,979,666·03 dols. represented in surplus of net revenue over dividends, interest, and sinking fund appropriations. For new property there was appropriated during the first quarter of the year 315,425·90 dols. Dating from January 1, 1882, the company has entered into contracts with the Gold and Stock Telegraph Company, and with the International Ocean Telegraph Company, to manage and operate the lines, property, and business of those companies for a term of ninety-nine years, guaranteeing to the stockholders quarterly dividends at the rate of six per cent. per annum, and being entitled to all revenues.

The statistics show :—In 1882, 131,060 miles of poles, 374,368 miles of wire, 12,068 offices, 38,842,247 messages sent, 17,114,165·92 dols. received, 9,996,095·92 dols. expended, leaving profit of 7,118,070 dols.—New York *Evening Post, 23rd October.*

Cables Repaired.—The cable between Fao and Bushire is repaired. The cable between St. Lucia and Martinique is repaired, and telegraphic communication with all places in the West Indies established.

A Bankrupt Telegraph Engineer. — Alexander Maclean, telegraph engineer, was examined in bankruptcy on Monday, in Edinburgh Bankruptcy Court. The sederunt consisted of Mr. George Watson, C.A., trustee; Mr. John Blair, W.S., agent in the sequestration and for the United Telephone Company, and Mr. Kelly, of Messrs. Boyd, M'Donald, and Jamieson, W.S., for the bankrupt. Examined by Mr. Watson, bankrupt stated that he commenced business about three years ago, after previous sequestration as an electrical engineer. He had no capital, and got assistance to the extent of about £150 from friends. He was never able to repay that sum. He attributed his non-success in business to having charged too low prices and to the disputes he got into with telephone patentees. He first found himself in difficulties when an action was raised against him by the United Telephone Company. If he had succeeded in the litigation, he had hopes that he would have retrieved himself. His liabilities, as appeared from his state of affairs, amounted to £1,725, and his assets, after deducting preferable claims, to £18. He became acquainted with the firm of Messrs. Harrison, Cox-Walker and Co. about a year ago, and had had several transactions with them. In June last he went to London principally to see the Electrical Exhibition. At that time he was not being greatly pressed by his creditors. While in London he met Mr. Walker, and ordered 1,000 transmitters. His reason for ordering the transmitters was that the United Telephone Company were applying for a disclaimer, and he wished his order given before they got their patent again. The transmitters had never been delivered to him. After further examination, the statutory oath was administered.

The Storms.—The *Scotsman*, commenting on the storm of Tuesday, says :—"With the occurrence of the first severe storm of the season, the inevitable result has happened —the telegraphic system of England has been completely disorganised, leading to much inconvenience and loss in the transaction of business throughout the country. With each succeeding year such a breakdown under the existing circumstances is rendered more and more certain. The trunk aerial lines are so much overweighted that they are unable to withstand such a strain as that of yesterday, and they are wrecked in all directions. The inconvenience was, in the case of newspapers, greatly increased yesterday by the fact that Parliament had just re-opened, thus necessitating a greatly increased telegraphic service. Our special reports have had, in consequence, to be considerably curtailed. A remedy for these constantly recurring interruptions of one of the chief services in the country is urgently called for. It has been provided in Germany, where a network of subterranean lines, placed beyond the reach of every storm, has been in successful operation for a considerable time; and an even more perfect system is being introduced in France. Could not something in the same direction be done at '

On the Galvanic Conductivity of the Non-metallic Bodies.—By M. Slouguinoff.—The feeble conductivity of the non-metals as compared with the metals seems to depend on a more complicated structure of the molecule. As the temperature rises the molecule grows more simple and the conductivity increases. Diamond is a non-conductor, because, according to Mendelejeff, its molecule is more complicated than that of graphite and charcoal. The molecule of conductive red phosphorus is simpler than that of the non-conductive yellow variety, as is confirmed by certain chemical considerations. Certain non-metals conduct in the gaseous condition, which is to be explained in the same manner.—*Wiedemann's Beiblätter.*

NEW COMPANY REGISTERED.

French Electrical Power Storage Company (Limited).—Capital £1,075,000, divided into 75,000 ordinary shares of £1 each and 100,000 preferred shares of £10 each. Objects: To acquire English or foreign inventions connected with electricity and electromotive force, or other similar agency. Signatories (with one share each): —Simon Philippart, 446, Strand; H. P. Girlain, 13, Percy Street, Bedford Square; W. Bradley, Surbiton; E. J. Dowlen, 107, Isledon Road, N.; A. Golden, 27, St. George's Road, Regent's Park; F. A. Pincoffs, 5, Warnford Court; J. Burton, 25, Maddox Street, W. Directing qualification, shares to the nominal value of £500; remuneration, £3,000 per annum. Registered 21st inst., by Campbell, Reeves, and Hooper, 17, Warwick Street, Regent Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

The following returns have been recently filed :—

Anglo-General Electric Light Company (Limited). —At an extraordinary general meeting of the above company, held on August 14th, it was resolved to transfer the goodwill, &c., to the Laing Electric Light and Power Company, in consideration of £75,000 in fully paid shares of that company. The last return of the Anglo-General was filed on March 28th. The nominal capital is £24,000, in £1 shares. 15,000 shares have been allotted, and sixpence per share paid up, the total calls paid amounting to £375.

Buenos Ayres Electric Light Company (Limited).— The return of this company, made up to March 8th, was filed on May 6th. The nominal capital is £100,000, divided into 9,986 shares of £10 each, and 70 founders' shares of £1 each, the latter shares being all at present issued.

Consolidated Telephone Construction and Maintenance Company (Limited).—The annual return of this company, made up to May 8th, was filed July 27th. The nominal capital is £300,000, in £1 shares. The number of shares allotted is 145,165 ordinary and 45,835 vendors'; upon the former £1 per share has been called, the latter being considered as fully paid. The calls paid amount to £154,165.

Croydon Electric Light Company (Limited).—The return of this company, made up to August 24th, was filed on August 25th. The nominal capital is £5,000, in £1 shares. 590 shares have been taken up, and 5s. per share called thereon. The calls paid amount to £95 and unpaid to £52 10s.

National Telephone Company (Limited).—The second annual return of this company, made up to the 1st ult. was filed 9th ult. The nominal capital is £600,000, in 15,000 preference shares of £10 each, and 90,000 ordinary shares of £5 each. The number of shares taken up is 105,000. Upon the preference shares £6 has been called, and the full amount upon each ordinary share. The calls paid amount to £539,618 and unpaid to £11,502.

Siemens Brothers and Company (Limited).—The return of this company, made up to May 15th, was filed on May 25th. The nominal capital is £400,000, in 4,000 shares of £100 each, the whole of which are allotted. A call of £75 has been made, the calls paid amounting to £300,000.

Midland Electric Light and Power Company (Limited).—The return of this company, made up to April 20th, 1882, was filed on May 11th. The nominal capital is £50,000, in £10 shares, but the only shares at present issued are those taken by the original subscribers.

NEW PATENTS—1882.

4976. "Improvements in ship's binnacles and compasses, whereby the compass is made to indicate the ship's course as corrected for leeway." R. E. Meilshemer. Dated October 19.

4988. "Construction of electric arc lamps." A. Serrailler. Dated October 19.

4991. "Improvements in secondary batteries, and in the manufacture of the same." J. E. Liardet and T. Donnithorne. Dated October 19.

5001. "Telephonic instruments." G. L. Anders. Dated October 20.

5002. "Fittings for incandescent electric lamps." M. Evans. Dated October 20.

5014. "Improved means of regulating electric currents, and electromotive force and apparatus therefor." L. Campbell. Dated October 21.

5015. "Electro-magnetic and magneto-electric engines." C. F. Varley. Dated October 21.

5016. "Electro-magnetic and magneto-electric engines." C. F. Varley. Dated October 21.

5017. "Electro-magnetic and magneto-electric engines." C. F. Varley. Dated October 21.

5019. "Iron and steel tubular telegraph poles, and manufacture of certain kinds of iron and steel tubes for telegraph poles, and for other purposes." J. C. Johnson and R. Martin. Dated October 21.

5023. "Carbons for incandescent electric lamps." M. Bailey. Dated October 21.

5035. "Lightning conductors." H. G. Haddan. (Communicated by J. Kernaul.) Dated October 21.

5050. "Improvements in and relating to electric lighting apparatus, which improvements are partly applicable for other purposes." H. H. Lake. (Communicated by S. F. Van Choate.) Dated October 23.

5055. "Generating and storing electricity and appliances connected therewith." F. H. Varley. Dated October 24.

5059. "Application of electricity to rotatory hair-brushes." N. J. Holmes. Dated October 24.

5060. "Machines and apparatus employed in the production, collection, and utilisation of electric or magnetic currents or forces." J. S. Fairfax. Dated October 24.

5078. "Improvements in secondary batteries, also applicable to ordinary galvanic batteries." A. F. Hill. Dated October 24.

5092. "Electric generators." E. Jones. Dated October 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1085. "Electro-magnets and armatures therefor." W. P. Thompson. (A communication from abroad by Gerritt Smith, of America.) Dated March 7. 8d. The object of this invention is to attain a greater degree of rapidity of vibration in the armatures of electro-magnets, such as are employed in telegraphic receiving instruments and other like mechanism, than has been possible with apparatus of this kind constructed in the usual manner. The invention is principally useful in connection with telegraphic apparatus, particularly in cases where unusual rapidity of signalling is necessary, as in Wheatstone's and other automatic systems. The invention consists in actuating the armature of the electro-magnet and its necessary mechanical attachments through the instrumentality of a constant mechanical power whose action is controlled by electro-magnetism, in lieu of causing the armature and its attachments to be actuated solely by the direct attractive force of the electro-magnet as heretofore. The inventor makes use of a cylinder or disc of magnetic metal, such as iron or steel, which is so mounted as to rotate upon an axis within a magnetising helix. An armature of iron or steel is maintained in permanent magnetic contact with the surface of said cylinder, and is so mounted as to be capable of receiving motion therefrom by friction. In some cases the inventor provides a spring or other retractor, which tends to exert a constant force upon said armature in a direction opposed to that which it derives from its frictional contact with the moving cylinder. Fixed stops, which are preferably made adjustable, are provided for the purpose of limiting the movement of the armature in each direction. The magnetising helix which surrounds the cylinder is included in an electric, or telegraphic circuit, and a suitable key or transmitter may be placed at some point in said circuit, which acts to alternately increase and decrease the strength of current traversing said circuit. Fig. 1 is a plan view of an apparatus illustrating one method of carrying out the invention, in which a part of the apparatus is broken away to exhibit the internal construction; and fig. 2 is a transverse vertical section, taken in the plane of the dotted line, 2, 2, in fig. 1. Referring to figs. 1 and 2, A represents a suitable base upon which the various parts of the apparatus are mounted; B is a helix or coil of thin insulated wire, which is wound upon a hollow bobbin, b, the lower flange of b^1 of which should be formed of ebonite or other insulating material. C is a cylinder of soft iron, fitting closely within the central opening of the hollow bobbin, b, but capable of rotating freely upon its longitudinal axis. The cylinder, C, forms the magnetic core of the helix, B. It preferably has an enlargement, or flange, c (fig. 2), formed upon its upper end. Upon the lower end of the cylinder, C, is fixed a small pulley, D, which revolves beneath the base, A. A belt or band, D^1, passes around the small pulley, D, and also around a larger pulley, E, which is also mounted in the same plane beneath the base, A, as shown in dotted lines in fig. 1. A crank, F, is affixed to that portion of the shaft, e, of the pulley, E, which projects above the base, A, by means of which crank it may be turned by the hand of the receiving operator in the direction indicated by the arrow. When the crank, F, is thus turned, the soft iron cylinder, C, constituting the core of the hollow helix, B, is caused to rotate rapidly in the direction indicated by the arrow in fig. 1. The

FIG. 1.

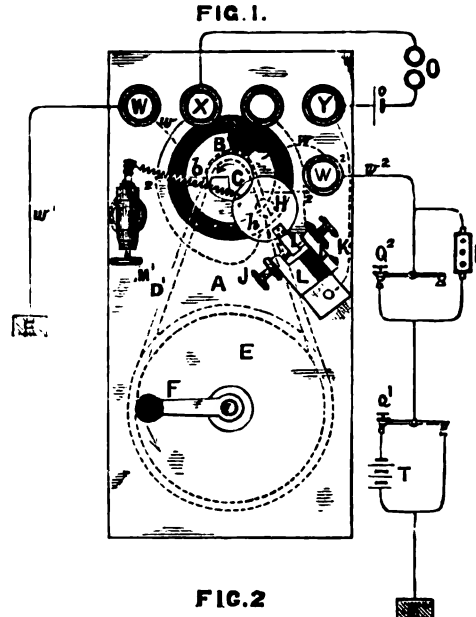
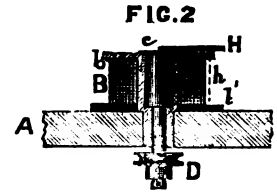


FIG. 2



upper surface of the soft iron cylinder, C, is polished, and is moreover carefully turned and fitted, so as to revolve as accurately as possible in a horizontal plane. H is an armature preferably formed of a thin flat disc of soft iron, a small portion of the periphery of which rests upon the upper surface of the cylinder, C, near the edge of the flange, as shown in figs. 1 and 2. The disc or armature, H, is capable of moving freely in a horizontal plane upon its vertical pivot or axis, h, but the extent of this horizontal motion is limited by a rigid arm or lever, I, affixed to the armature and moving with it, which plays between fixed stops, J and K. These stops may with advantage be rendered adjustable by mounting them upon screws, or other well-known equivalent devices, as shown in fig. 1. The stop, J, is mounted upon a standard, L, upon the base, A, and the stop, K, is mounted upon a bracket, l, secured to but insulated from the standard, L. The retractor, M, consists of a spiral spring attached to the armature, H, preferably at a point in its periphery diametrically opposite to the point of attachment of the arm, I. The retractor is capable of adjustment by means of the milled-head and spindle, M^1, or other suitable means, so as to exert a constant force of any required amount upon the armature, H. The helix, B, terminates in the projecting wires, w, w, which are electrically connected to the binding screws, W^1, W^2, and serve to form a connection with the main line. The apparatus thus constructed is placed at a receiving station in the circuit of a telegraph line, the connections being completed in the ordinary manner by means of a wire, w^1, connecting the terminal post, W^1, with the earth at the receiving station, while the line wire, w^2, coming from the transmitting station, is attached to the terminal post, W^2. The key at the transmitting station may either be arranged to open and close the circuit of the main battery, T, as shown at Q^1, or it may be inserted in the manner shown at Q^2, so that when closed it will shunt a constant resistance, R, normally interposed in the line, and thus act simply to alternately increase and decrease the strength of current in the line, without interrupting the circuit. The operation of the apparatus is as follows:—When a telegraphic communication is to be received upon the instrument, the cylinder, C, which forms the core of the coil, B, is caused to rotate upon its axis in the direction indicated by the arrows, which may be effected by turning the crank, F, as hereinbefore explained. So long as no electric current traverses the coil, B, the friction between the cylinder, C, and the armature, H, which rests lightly upon it, will be so small that the cylinder will have but a slight tendency to drag the armature along with it, and this tendency will be overcome by the resistance of the spring, M, so that the armature will remain in its normal position (shown in fig. 1), the arm, I, resting in contact with the rear stop, K. When, however, an electric current is transmitted through the line, as by the depression of the key, Q^1, the cylinder, C, instantly becomes magnetic by the inductive influence of the coil, B,

and attracts the armature, H, which rests upon its periphery. The pressure produced by this magnetic attraction increases the friction between the two surfaces to such an extent, that the antagonistic force of the retracting spring, M, is overcome, and the armature, H, is caused to turn upon its axis by the force imparted thereto by the friction of the rotating cylinder, C. Hence the arm, I, is brought into contact with the stop, J, in which position it remains so long as the electric current from the transmitting station continues to traverse the coil, B. When the current is interrupted by the raising of the key, Q^1, the attraction between the cylinder, C, and the armature, H, ceases, whereupon the recoil of the spring, M, instantly restores the armature, H, and its attached arm, I, to their normal position. In case it is desired to operate the apparatus by an alternate increase or decrease in the strength of a constant current, as for example, by manipulating the key, Q^2, the tension of the retracting spring, M, is so adjusted that the friction due to the magnetism induced by the normal or minimum strength of current is not quite sufficient to overcome its tension, but any increase of friction beyond the normal amount will overcome the spring, and instantly communicate a lateral movement to the armature, H, in the manner hereinbefore explained.

1142. "Regulating the generative capacity of dynamo or magneto-electric machines." T. J. Handford. (A communication from abroad by T. A. Edison, of America.) Dated March 9. 6d. The object of this invention is to provide simple and efficient means for regulating the generative capacity of dynamo or magneto-electric machines by acting upon the commutator brushes or springs to move them away from and towards the points of greatest difference in potential or most effective generation. This object is accomplished by a mechanism which is both actuated and controlled by the current generated. For this purpose is used a double or single motor, or motor-like mechanism, connected with the commutator brushes, so as to move them together in one or the other direction. The electric circuits to this mechanism supplied by the current generated are made and broken by an electro-magnet also energised by the current generated by the machine. In carrying out this invention, the arms carrying the commutator brushes are mounted on a yoke pivoted upon the journal box next to the commutator cylinder and around the armature shaft. The yoke also carries a worm wheel, with which engages a worm. Secured to this worm are two ratchet wheels with teeth raking in opposite directions. With these wheels engage two pawl bars carried by armature-levers. The lower ends of the armature levers engage with circuit makers and breakers which are pivoted, Y-shaped pieces playing between contact screws and making their forward contacts when the armature-levers are retracted, and their back contacts when such levers are drawn forward by their electro-magnets. An electro-magnet (the controlling device) is placed in a multiple arc circuit from the main conductors of the machine. A resistance is also placed in the same circuit. An adjustable shunt around more or less of this resistance, as desired, has one part connected with the Y-shaped circuit controllers and the other part with the armature-lever of this controlling magnet. The front and back contacts of this last armature-lever are connected with the coils of the two electro-magnets first mentioned, and from the other ends of these magnet coils connections are made with the front contacts of the Y-shaped circuit controllers. A spring arm is employed to determine the central position of the armature-lever of the controlling magnet. When there is the desired degree of generation to supply the translating devices in circuit, the controlling armature-lever stands in a central position, leaving the circuits to both of the vibrating mechanisms open; but a decrease or increase beyond fixed limits, caused by a change in the number of translating devices, or by other reasons, produces a movement of the armature-lever of the controlling magnet and a closure of one or the other circuit to the vibrating mechanisms. The mechanism in circuit operates continuously until the brushes are adjusted to the desired point, when its circuit is broken by the controlling magnet.

1172. "Incandescence electric lamps, &c." J. Wauthier. Dated March 10. 6d. Relates to improvements in incandescence electric lamps, and has for its object first to obtain a greater body of light in a small compass by making the carbon filament of peculiar form, so as to get a greater length of filament than usual. The invention has for its object secondly to lessen the number of joints in the conducting wires and to more effectually protect the said wires, and to avoid twice sealing the exhaustion tube and more effectually protect the same and reduce the labour and cost of manufacture.

CITY NOTES, REPORTS, MEETINGS, &c.

WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

Under the presidency of Robinson Kendal, Esq., chairman of the board, the fifth ordinary general meeting of the shareholders of this company was held at Cannon Street Hotel on Monday.

The notice convening the meeting having been read by the secretary, Frederick L. Robinson,

The Chairman said: In rising to move the adoption of the report and to say a few words in regard to it, I may in the first instance say why it is issued at so comparatively late a period. You all know that a state of war and a state of semi, if not of actual, censorship exists on the coast, and that it is impossible in the present disorganised state of the postal and other arrangements of the country to count upon anything like regularity in the transmission of accounts and correspondence. As a matter of fact, it often happens that letters come to hand two or three mails behind time, other letters written weeks after arriving before them. This, I need not say, is a serious matter when some three months are taken to send out an inquiry and receive an answer by post; and hence it is that our accounts are issued so late in the year. Next year we hope we shall not only have a better and more promising balance-sheet, but we hope to issue it at an earlier date. As regards the report itself I may say, although it is not so favourable as the board could wish, it is yet as satisfactory as under all known circumstances we could reasonably expect it to be. Whilst reducing our expenditure we have increased our income by the sum of £15,000 for the year, and we have to show a net profit of £1,308, a result, as the report shows, which will probably be looked upon as satisfactory, regard being had to the continuance of this deplorable war, and considering that Lima, one of our terminal stations, was only open half the year; whilst Mollendo, another of the company's stations, was blockaded by the Chilian fleet during the whole year. We have increased our staff upon the coast this month by two clerks, and we are sending out two more clerks in anticipation of increased traffic and work. Notwithstanding this increase of our expenditure, I have reason to think that our expenditure as a whole will be less than at present, for there are some items in our expenditure, to which I need not now call attention, which will be reduced, and others which will disappear altogether. As it is, and as the report shows, we have this year paid all the interest on our debentures, as well as an item of £8,299 15s. 8d. outstanding, due by the company, and we have now a respectable balance at the bank. As regards the future of the company, and not to indulge in predictions and expectations, I think that without counting upon the possibility of peace being restored, we shall have a sensible addition to our present income, and that from our own work, to say nothing of our connection with the new and extensive lines touching the Pacific over 3,000 miles until they reach Mexico and the United States. We shall be able to show in our next report what the present report foreshadows, a considerable improvement in the position and prospects of the company. The guano contract was set for 1,000,000 tons during the past week, and the shipment must bring necessarily increased business to the coast; but as a matter of fact, and speaking broadly, it is not a guano contract that is wanted on the coast, but peace—peace between Chili, Peru, and Bolivia. At Taltal there was opened, recently, another of those small lines of railway, running inland from the coast; and from this, under anything like a settled state of things, something in the way of increased trade and commerce may be expected. But it is not to systems of steam locomotion or steam navigation we must look, but to the restoration of peace and the general re-establishment of something like credit, commerce, and industry. As a trading company—for we are neither more nor less—it is not our province to interfere with political questions; it is our business to be the friends of all, and offensive to none. Still it cannot be out of place to think it possible to bring the war to a happy issue. We all know the trading condition of Lima; it is summed up in this, the rate of exchange is 2½d. per dollar. What the rate of exchange is the state of trade is, and what the state of trade is we all know. We can, however, only hope for better days, and nothing would give me greater pleasure than to be able to announce to-day that peace had been concluded between Chili, Peru, and Bolivia. As regards the company's claim, I must ask you to leave that in the hands of the board. It involves questions of municipal and international law, as well as questions of right and justice; and this is not the place to discuss these. Of this you may rest assured, that the board will not cease to press their claim, which they believe to be fair and just, and unless the Chilian Government is to belie its high reputation for honesty and honour, it will not be pressed in vain. With these remarks, I beg to move the adoption of the report.

Mr. T. F. Campbell seconded the motion, which, on being put to the meeting, was carried unanimously.

Mr. T. F. Campbell then proposed the re-election of the retiring directors, Mr. R. Kendal (the Chairman) and Mr. Matthew Gray.

Mr. Scott seconded, and this proposition was also carried.

The Chairman briefly returned thanks, remarking that the shareholders worked very hard in the interests of the company. Nothing could be done which had not been done for the interests of the company in the circumstances in which the board had been placed.

Mr. Mason next proposed the re-election of the retiring auditor, Mr. J. Weise, of Turquand, Youngs and Co.

This was seconded by Captain Marshall, and Mr. Weise was re-elected.

Mr. Mason, in proposing a vote of thanks to the Board, remarked that he considered the accounts satisfactory, and he thought the company about the most carefully managed one of its kind. He hoped Mr. Kendal's anticipations might be realised.

In reply the Chairman said on the last occasion of their meeting there they had amongst them their old friend, Colonel Tilney, who has since died. He left a testamentary document that his shares in this company were not to be sold but to be kept for his family, a great proof of confidence in the company. He hoped the board would always have regard to the fact that they were trustees, and will endeavour to do the best for the shareholders.

The proceedings then terminated.

ELECTRIC SUN LAMP COMPANY.

The first statutory meeting of the above company was held in Cannon Street Hotel on Tuesday last, Sir James Carmichael presiding. The secretary, Mr Pennell, having read the notice convening the meeting, Sir James said: Gentlemen, my first duty is to apologise on behalf of our chairman for his unavoidable absence. You are all aware that this meeting is a formal meeting, what is called a statutory meeting convened under the act, and at such meeting no report or accounts are submitted to the shareholders. At the same time I think it would be satisfactory to you for me to state very briefly the present position of the company, and what it has been doing, and if any gentlemen present desires to ask me any questions, I shall be

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 258.

THE *BONA FIDES* OF ELECTRIC LIGHTING.

The statements which have at intervals been so carefully and ingeniously propagated regarding the extraordinary efficiency of the Ferranti machine, although not taking so great an effect on the public mind as was doubtless anticipated, have produced a certain amount of uneasiness amongst the shareholders of the Anglo-American Brush Electric Light Corporation and its subsidiary companies, if we may judge by the circulars issued by the parent company and its offspring the South Eastern Brush. This, however, is not to be wondered at, and the directors of the Anglo-American Corporation are quite justified in using every endeavour to appease the natural alarm occasioned amongst those interested in the future of the Brush system.

It is perhaps only just to mention in the first place that the success which the Brush system has achieved is due in a great measure to the commercial abilities of Mr. Robert Hammond, the founder of the company called after his name, who at first was the sole agent for the Brush light, and if the Hammond Company can secure a better system, as it professes to have done, we do not know why anything should be said against such a proceeding.

In a former article we touched upon several points contained in the prospectus of the Ferranti system issued by the Hammond Company. At present, as far as we are aware, the only direct information obtainable regarding Ferranti's invention has to be sought for in the pages of the above-mentioned circular. We have recently had brought to our notice by a friend unconnected with any electric light company's interests a circumstance connected with the wording of this pamphlet which, although of importance, might easily be overlooked.

The circular commences thus :—

THE "FERRANTI" SYSTEM

OF

ELECTRIC LIGHTING.

Sole Agents:

The Hammond Electric Light and Power Supply Company (Limited).

Advantages of the Electric Light.

During the last two years the electric light has become so familiar an object throughout this country, and the benefits arising from its use are now so generally acknowledged, that very little new information can be given under this head. The prominent position, however, taken by this company (the Hammond) in the erection of electric light apparatus enables us to speak with a considerable degree of authority upon the practical outcome of the trials made at the leading works in every branch of industry.

Then follow the names of places where electric lights to the number of over 550 have been installed, as we understand it, by the Hammond Company. In no case can we find it mentioned that these installations were on the Brush system, and therefore the obvious inference forced on the mind of the uninitiated reader is that all this applies to the Ferranti invention.

A correspondent in the last number of the Electrical Review made some pertinent remarks concerning the share taken by the *Times* in bringing the Ferranti machine before the public, but we consider the omission of the name to which we have just called attention much more deserving of censure than anything which has been published in the columns of the leading daily paper.

It seems that statements misleading in a certain degree are common to all electric light companies, but we do not think that such circumstances in the majority of instances occur knowingly, but more because sufficient experimental data concerning the absolute capabilities of any given system is not forthcoming, and it is then necessary to theorise or draw upon the imagination as to what degree of efficiency may be at least hoped for. We agree with the directors of the Anglo-American Brush Electric Light Corporation, that it is premature to promulgate rash statements as to the capabilities of machines which have not yet been constructed—or at any rate but experimentally—and that we can only arrive at a definite conclusion on the efficiency of such apparatus when tests have been made which can be supported by independent and reliable evidence. In regard to this point, we hope that some day we may have independent and reliable testimony concerning the candle-power of a Brush lamp when a given horse-power is being expended.

We have only called attention to one fact in the pamphlet issued by the Hammond Company, but there are others deserving attention. Although we have thought fit to express ourselves as to the *bona fides* of, not so much the Ferranti system, as the manner in which the invention is brought forward, the "scare" occasioned has been of some service, for the Brush directors have come to the conclusion that the time has arrived for a general reduction of the prices of dynamo-electric machines and lamps. This in itself is not only an advantage to the public, but the Brush system will gain in the end. New inventions are not so much required as low prices for existing apparatus, and if a tendency towards reduction in this direction has been accomplished by the rumours regarding the Ferranti machine, then it may, *perhaps*, sometimes be excusable to work a little evil to perform a great good. We are glad to observe that the Anglo-American Brush Corporation is on the point of bringing forward dynamo-electric machines specially constructed for the purpose of lighting by incandescence. Up to the present we do not know of any thoroughly successful effort at electric lighting by means of the present Brush system with Lane-Fox lamps, for the difficulties attached to arranging a circuit combining arc and incandescence lamps are much greater than have to be encountered in the ordinary arrangement of lighting by incandescence.

To place the lamps in the positions required in a straggling place gives rise to a special difficulty which we shall bring before our readers in the course of the next week or two. This difficulty, we may add, will obtain equally with the Ferranti machine, if both arc and incandescence lamps are actuated by the current from the same machine.

great trouble and annoyance. We are pledged, as has often been said before, to publish a great quantity of the market prices of the materials in which the West Indian colonies deal, and we are pledged to publish the movements of the mail steamers, lists of passengers, and the general news of the world. Of course this is not only a very onerous and difficult duty for the telegraph company, which is not a news agency, but it eats into the legitimate sources of the revenue. It is very much the same thing as if you were to ask railway companies from the north to supply everybody in London with coals. It is really giving for nothing the material upon which we ought to live, and it is not only disadvantageous to us in that respect, but it also causes great discontent in the matter that those who are supplied with news are never satisfied. I can quite understand that in an outlying part of the country where you get up in the morning and call for a newspaper in which these bulletins are contained, that you might be inclined to grumble. Even in the *Times* here you often hear it said, "There is no news in the paper." The English colonists complained that we gave nothing but French news, and the French colonists complained that we gave nothing but English news, and so between the two we were in bad odour all round, where it was not our fault. These requirements are difficult to meet, and it does not seem to me that the conference took much trouble to inquire whether they were reasonable requirements or whether we could fulfil them. However, the scheme, as proposed, was carried unanimously by the delegates. I do not myself believe very much that this scheme will come to anything. I do not think that our Government is inclined to put down £350,000 in cables for the colonies; they have never done so yet, and I don't expect they will. I very much doubt that the smaller colonies, when they come to understand what is meant by this measure, will join in it. That those colonies, with a revenue of £30,000 a year, should have to stand the work of heavy repairs in the Atlantic I think will frighten them out of it. When you think that some of the cable repairs cost as much as £90,000 in one repair, I think probably that will rather make the colonies cool a little before going into such a business. As the matter stands now, Mr. Kingsford, our representative, has visited the different colonies, and so I am not without hopes that some good will come from his representations and interviews. I may tell you that I have seen this morning the Receiver-General of Trinidad, and he authorises me to say that the subsidy of that colony has been increased, and is in the estimates for the current year from £2,500 to £6,000, which will be regularly paid, unless this scheme should come to anything, on the line from Bermuda to Nova Scotia, which I don't believe. I think that is perhaps a sign of rather more liberal and just feeling towards us, and am not without hope that perhaps with some concessions on our part we may be able to get the colonies with us. I think nobody is likely to take our place in a losing concern like this. The Americans have laid a cable down on the West Coast of Mexico, touching Panama, and joining with the West Coast cable lines at Lima. I think that is all I have to tell you. We feel very much the unfortunate results of this enterprise, but we are convinced that it is entirely owing to the ground upon which we have to work, and that nothing further can be done except by alteration of the terms which were originally entered upon. I now beg to move that the directors' report and accounts to June 30th, 1882, submitted to this meeting, be and the same hereby are, received and adopted.

Mr. Ford seconded the motion.

Mr. Abbott said that doubtless the meeting was surprised at the extraordinary announcement which had been confirmed in the report. Instead of the West Indian colonies rendering the company any assistance, they had in contemplation a magnificent scheme to assist the colonists. If their plea was poverty, how was it that they could find £650,000 contingent on the English government finding them £350,000 to compete with capital already lying dormant (hear, hear)?

Mr. Bears thought they would have listened to Mr. Abbott's remarks with more attention if he had prefaced them by saying that he had gone to America in the interests of the shareholders of the West Indian and Panama Company (laughter).

Mr. Abbott, in moving a vote of thanks to the chairman, hoped that some arrangement might be come to whereby all their money would not be swallowed up in repairs. It was time some such plan was matured.

Mr. Robinson Kendall seconded the motion, which was carried by acclamation.

The Chairman briefly expressed his thanks, and the proceedings terminated.

THE INDO-EUROPEAN TELEGRAPH COMPANY (LIMITED) has given notice that an interim dividend for the half-year ending 30th June last at the rate of 5 per cent. per annum, free of income-tax, will be payable on and after the 1st November next, on all shares standing registered in the company's books on the 23rd day of October, 1882. Coupons held in this country must be deposited at the company's London bankers, Messrs. Barclay, Bevan, Tritton, Twells, and Co., No. 54, Lombard Street, E.C., three clear days before payment, for the purpose of verification.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—We are informed that the board has resolved upon the payment of an interim dividend of five shillings per share, being at the rate of five per cent. per annum for the quarter ended 30th September, 1882, such dividend to be payable on and after the 16th November next.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY (LIMITED) announces a distribution at the rate of 1s. 2d. per £5 Second Bonus Trust Certificate on November 1st, and payable two clear days after presentation of coupon No. 15 at Messrs. Barclay, Bevan, and Co.'s Bank, 54, Lombard Street.

THE EASTERN EXTENSION TELEGRAPH COMPANY (LIMITED) notifies that the coupon due November 1st on their Five per Cent. Debentures will be paid at the Consolidated Bank, 52, Threadneedle Street. Coupons to be left three clear days for examination.

"BRUSH" ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND (LIMITED).—Mr. N. W. Levin has retired from the board of this company on account of his approaching visit to New Zealand.

SUBMARINE TELEGRAPH COMPANY.—Owing to the cables of this company being interrupted by the storm of Tuesday last, the receipt of telegrams from the Continent has been greatly interrupted.

AUTOMATIC TELEGRAPH.—Creditors must send in their claims on or before the 21st November to Mr. S. M. Richards, of 141, Fenchurch Street, E.C., the liquidator.

APPLICATIONS have been made to the Committee of the Stock Exchange for a special settling day in the shares of Edison's Indian and Colonial Electric Company (Limited), and for a quotation in the shares of the Gülcher Electric Light and Power Company (Limited).

A SPECIAL settling day has been granted the Anglo-Austrian Brush Electrical Company (Limited) shares, namely, Tuesday, 24th October, 1882.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Oct. 25.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	10½-11	[illegible]
		Do. Do.	10	21 - 25	[illegible]
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1¼- 1¾	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1 - 1½	
25,000	5	Great Western Electric Light & Power Co.	2½	¾- 1¼	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	6 -6½	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1¼- 1¾	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	[illegible]	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1½- 2	[illegible]
..	..	South African Brush Electric Light & Power Co.	2½	¾- 1¼	
100,000	5	Swan United Electric Light Co., Limited	2	1½-2½	[illegible]
		TELEGRAPHS.			
2,116,400l.	Stk.	Anglo-American, Limited	100	49½- 50½	
2,441,800l.	Stk.	Do. Preferred } Def'd. receiving no div. until	100	80 - 81	[illegible]
2,441,800l.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19 - 20	[illegible]
130,000	10	Brazilian Submarine, Limited	10	12 -12½	[illegible]
16,000	10	Cuba, Limited	10	9½- 10½	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	[illegible]
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12½	
100,000l.	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10½-10¾	[illegible]
70,000	10	Do. 6 per cent. Preference	10	12½- 13½	
232,000l.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000l.	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000l.	100	Do. 5 do. do. Aug. 1899	100	101 -104	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11¼- 11¾	[illegible]
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -106	
140,000	100	Do. do. registered, repayable 1900	100	102 -106	
100,000l.	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300l.	100	{ Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	102 -105	
345,700l.	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	[illegible]	
163,300	10	Globe Telegraph and Trust, Limited	10	[illegible]	[illegible]
163,209	10	Do. 6 per cent. Preference	10	[illegible]	
125,000	10	Great Northern	10	[illegible]	
100,000l.	100	Do. 5 per cent. Debentures	100	[illegible]	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	[illegible]	
100,000	100	Do. 6 per cent. Debentures, 1896	100	[illegible]	
17,000	25	Indo-European, Limited	[illegible]	[illegible]	
38,148	10	London Platino-Brazilian, Limited	[illegible]	[illegible]	
12,000	10	Mediterranean Extension, Limited	[illegible]	[illegible]	
8,200	10	Do. 8 per cent. Preference	[illegible]	[illegible]	
9,000	8	Reuter's, Limited	[illegible]	[illegible]	
280,000	Stk.	Submarine	[illegible]	[illegible]	
58,225	1	Do. Scrip	1	[illegible]	
4,200	Cert	Submarine Cables Trust	[illegible]	[illegible]	[illegible]
37,350	12	Telegraph Construction and Maintenance	[illegible]	[illegible]	[illegible]
150,000	100	Do. 6 per cent. Bonds, 1891	[illegible]	[illegible]	
186,750	5	Do. 2nd Bonus Trust Cert.	[illegible]	[illegible]	
30,000	10	West Coast of America, Limited	[illegible]	[illegible]	
150,000	100	Do. 8 per cent. Debentures	[illegible]	[illegible]	
69,910	20	Western and Brazilian, Limited	[illegible]	[illegible]	
200,000l.	100	Do. 6 per cent. Debentures "A" [illegible]	[illegible]	[illegible]	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., [illegible]	[illegible]	[illegible]	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) [illegible]	[illegible]	[illegible]	
1,030,000l.	100	Do. 6 per cent. Sterling Bonds	[illegible]	[illegible]	
88,321	10	West India and Panama, Limited	[illegible]	[illegible]	
34,563	10	Do. 6 per cent. 1st Preference	[illegible]	[illegible]	
4,669	10	Do. 6 do. 2nd do.	[illegible]	[illegible]	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. [illegible]	[illegible]	[illegible]	
200,000	1	Oriental Telephone Co., Nos. 100,0[illegible]	[illegible]	[illegible]	
100,000	5	United Telephone Co.	[illegible]	[illegible]	

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 258.

THE *BONA FIDES* OF ELECTRIC LIGHTING.

THE statements which have at intervals been so carefully and ingeniously propagated regarding the extraordinary efficiency of the Ferranti machine, although not taking so great an effect on the public mind as was doubtless anticipated, have produced a certain amount of uneasiness amongst the shareholders of the Anglo-American Brush Electric Light Corporation and its subsidiary companies, if we may judge by the circulars issued by the parent company and its offspring the South Eastern Brush. This, however, is not to be wondered at, and the directors of the Anglo-American Corporation are quite justified in using every endeavour to appease the natural alarm occasioned amongst those interested in the future of the Brush system.

It is perhaps only just to mention in the first place that the success which the Brush system has achieved is due in a great measure to the commercial abilities of Mr. Robert Hammond, the founder of the company called after his name, who at first was the sole agent for the Brush light, and if the Hammond Company can secure a better system, as it professes to have done, we do not know why anything should be said against such a proceeding.

In a former article we touched upon several points contained in the prospectus of the Ferranti system issued by the Hammond Company. At present, as far as we are aware, the only direct information obtainable regarding Ferranti's invention has to be sought for in the pages of the above-mentioned circular. We have recently had brought to our notice by a friend unconnected with any electric light company's interests a circumstance connected with the wording of this pamphlet which, although of importance, might easily be overlooked.

The circular commences thus :—

THE "FERRANTI" SYSTEM
OF
ELECTRIC LIGHTING.

SOLE AGENTS:
THE HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY (LIMITED).

Advantages of the Electric Light.

During the last two years the electric light has become so familiar an object throughout this country, and the benefits arising from its use are now so generally acknowledged, that very little new information can be given under this head. The prominent position, however, taken by this company (the Hammond) in the erection of electric light apparatus enables us to speak with a considerable degree of authority upon the practical outcome of the trials made at the leading works in every branch of industry.

Then follow the names of places where electric lights to the number of over 550 have been installed, as we understand it, by the Hammond Company. In no case can we find it mentioned that these installations were on the Brush system, and therefore the obvious inference forced on the mind of the uninitiated reader is that all this applies to the Ferranti invention.

A correspondent in the last number of the ELECTRICAL REVIEW made some pertinent remarks concerning the share taken by the *Times* in bringing the Ferranti machine before the public, but we consider the omission of the name to which we have just called attention much more deserving of censure than anything which has been published in the columns of the leading daily paper.

It seems that statements misleading in a certain degree are common to all electric light companies, but we do not think that such circumstances in the majority of instances occur knowingly, but more because sufficient experimental data concerning the absolute capabilities of any given system is not forthcoming, and it is then necessary to theorise or draw upon the imagination as to what degree of efficiency may be at least hoped for. We agree with the directors of the Anglo-American Brush Electric Light Corporation, that it is premature to promulgate rash statements as to the capabilities of machines which have not yet been constructed—or at any rate but experimentally—and that we can only arrive at a definite conclusion on the efficiency of such apparatus when tests have been made which can be supported by independent and reliable evidence. In regard to this point, we hope that some day we may have independent and reliable testimony concerning the candle-power of a Brush lamp when a given horse-power is being expended.

We have only called attention to one fact in the pamphlet issued by the Hammond Company, but there are others deserving attention. Although we have thought fit to express ourselves as to the *bona fides* of, not so much the Ferranti system, as the manner in which the invention is brought forward, the "scare" occasioned has been of some service, for the Brush directors have come to the conclusion that the time has arrived for a general reduction of the prices of dynamo-electric machines and lamps. This in itself is not only an advantage to the public, but the Brush system will gain in the end. New inventions are not so much required as low prices for existing apparatus, and if a tendency towards reduction in this direction has been accomplished by the rumours regarding the Ferranti machine, then it may, *perhaps*, sometimes be excusable to work a little evil to perform a great good. We are glad to observe that the Anglo-American Brush Corporation is on the point of bringing forward dynamo-electric machines specially constructed for the purpose of lighting by incandescence. Up to the present we do not know of any thoroughly successful effort at electric lighting by means of the present Brush system with Lane-Fox lamps, for the difficulties attached to arranging a circuit combining arc and incandescence lamps are much greater than have to be encountered in the ordinary arrangement of lighting by incandescence.

To place the lamps in the positions required in a straggling place gives rise to a special difficulty which we shall bring before our readers in the course of the next week or two. This difficulty, we may add, will obtain equally with the Ferranti machine, if both arc and incandescence lamps are actuated by the current from the same machine.

THE DJEDDAH-SOUAKIN CABLE.

GENTLEMEN,—I beg to send you, enclosed herewith, my report on the electrical condition of the Submarine Telegraph Cable manufactured by you for the Telegraph Department of the Turkish Government, and which you have laid between Djeddah and Souakin in the Red Sea, during the month of August in the present year.

I remain, Gentlemen, your faithfully,

FRANK JACOB,
Chief Electrician.

Messrs. Siemens Brothers & Co. (Limited),
Telegraph Works, Woolwich, and
12, Queen Anne's Gate, London, S.W.
October 21st, 1882.

REPORT

On the electrical condition of the Submarine Telegraph Cable manufactured by Messrs. Siemens Brothers and Co. (Limited) for the Turkish Telegraph Department, and submerged by them between Djeddah and Souakin.

The core consists of a strand of 7 copper wires, weighing 107 lbs. per nautical mile, covered with six layers of gutta-percha, without alternate layers of compound, weighing 140 lbs. per nautical mile.

The cable was shipped on board the s.s. *Rochefort*, on July 24th, 1882. The following are the results of the tests then taken :—

Ship tank.	Length in nautical miles.	Conductor resistance in ohms.		Electrostatic capacity in microfarads.*		Dielectric resistance per nautical mile reduced to 75° Fahr. in megohms.					Temperature of cable, Fahr.
		Total observed.	Reduced to per n. m. at 75° Fahr.	Total.	per naut. mile.	1 min	2 min.	3 min.	5 min.	10 min.	
1	79·086	885·70	11·49	23·688	0·2996	3366	3866	4117	4405	4778	62° 5
2	19·791	216·35	11·30	6·212	0·3139	2035	2225	2297	2414	2574	59° 5
3	95·158	1067·32	11·51	28·832	0·3029	3328	3769	3980	4124	4517	62° 5
3	2·030	22·487	11·43	0·6050	0·2995	2895	3434	3691	3885	4343	62° 5
3	4·035	44·673	11·36	1·249	0·3025	3453	3861	4075	4659	5060	62° 5

The submergence of the cable was commenced from Djeddah on the night of the 22nd of August, and the shore-end landed at Souakin and the final splice made.

The following are the results of the electrical tests taken at Souakin, twelve hours after completion, on August 27th, 1882 :—

Length of cable : 187·660 nautical miles.

Conductor resistance : 2115 ohms, or 11·27 ohms per nautical mile. Mean temperature of the cable by comparison with the sum of the resistances measured at 75° = 66° Fahrenheit.

Electrostatic capacity : 56·18 microfarads, or ·2994 microfarads per nautical mile.

Dielectric resistance per nautical mile, as observed (in megohms) : 1st minute, 9,382 ; 2nd minute, 11,035 ; 5th minute, 15,013 ; 10th minute, 18,760.

The results were exactly the same with both positive and negative currents, and absolutely undisturbed by earth currents.

Dielectric resistance of 1st minute reduced to 75° Fahr., and a pressure of one atmosphere = 3,394 megohms per nautical mile.

The values calculated from the sum of those obtained at the works for each coil tested at 75° Fahr. are for the whole cable :

Conductor resistance	=	11·49 ohms per nautical mile.
Electrostatic capacity	=	0·2984 microfarads „
Dielectric resistance	=	2140 megohms „

Twenty-four hours after completion the cable was tested by M. Emile Lacoine, the representative of the Ottoman Telegraph Department, with the results given below :

Length of cable .	=	187·660 nautical miles.
Conductor resistance	=	11·32 ohms per nautical mile.
Electrostatic capacity	=	0·2982 microfarads „ „
Dielectric resistance	=	8563 megohms. „ „
Do., reduced to 75° Fahr.	=	4982 megohms. „ „
Mean temp. of the cable	=	68° Fahr.

(*Signed*) FRANK JACOB,
Chief Electrician.

* The electrostatic capacities here, as in all tests, are measured by the "balance method;" the values in this case are slightly higher than their true values, owing to the self-induction of the cable as coiled in the tanks.

THE TELEGRAPH.

IN the *New York World* of October 11th we read that on the previous evening, "A banquet was given to Mr. John Pender, M.P., by the Executive Committee of the Western Union Telegraph Company, at Delmonico's Hotel. Dr. Norvin Green presided, supported by General Thomas F. Eckert. The invited guests were Mr. David Dudley Field, Mr. Russell Sage, Congressman Abram S. Hewitt, Judge John F. Dillon, Mr. Chauncey M. Depew, General Horace Porter, General Wager Swayne, General G. Winslow, Mr. Jay-Gould, Mr. Cyrus W. Field, Mr. Samuel Sloan, Mr. William Dowd, Mr. J. T. Terry, Mr. C. P. Huntington, Mr. John Van Horne, Mr. George I. Gould, Mr. R. M. Gallaway, Mr. A. L. Hopkins, Mr. G. Fitzgerald, and Mr. William D. Bishop. Mr. Pender occupied the seat on the right of the President. After dinner there was some general conversation, and Dr. Green proposed the guest of the evening."

Mr. Pender, in replying, made a very interesting speech, an abstract of which, derived from the above source, will be found below. Having dealt first with the statistics of the telegraph, he next, by inference, exalted *the honour of the responsibility* of those at the head of the telegraphs to an equality with that of the Presidentship of the United States. He then alluded to a reduction in "the expense of the system to the press, as to enable them to use it more largely than they have hitherto done." Can it be that the news, telegraphed from Philadelphia a few days later, had already reached the astute Chairman of the Direct United States Cable Company, to the effect that four influential American newspapers have subscribed the stock in the new Baltimore and Ohio Cable Company ? Afterwards he entered into comparisons of American and English telegraphy, and drew somewhat unfavourable conclusions so far as the Government monopoly of Great Britain is concerned; but we will let his words speak for themselves, they run as follows :—

"Mr. Chairman and Gentlemen : My visit to America has been one of the greatest possible satisfaction to me and it is with great regret that I shall depart from among you. My impression on leaving America after having seen its vast resources, its energetic people, its daily development and the immense extent of territory which has yet to become productive, is that England ought of all things to be proud of America. The relations which now exist betwixt the old country and the new are simply those of two branches of the same family. Progress is apparent here even in a more eminent degree than in England, because here there is a larger field for enterprise. In that development England must largely participate, because it cannot fail to have the effect of increasing the trade betwixt the two countries. In speaking of the future of telegraphy, one cannot overlook the wonderful strides of commerce during the last fifty years. It has grown twelve times faster than population. It is made up of two unequal items, imports and exports. The trade of the world is at the present moment represented by £2,787,000,000, composing the two unequal items of imports and exports. All that large amount of commerce is more or less moved by the telegraph. There is not an operation of any magnitude that does not originate through the telegraph. The nineteenth century shows a remarkable increase in the number of people constituting the civilised nations of the earth. It has doubled in a single lifetime. In 1801 there were 192,000,000 of civilised people; in 1880, 365,000,000. The population of the United States in 1800 was, according to the census, a little over that of Portugal, which has 5,000,000 inhabitants. The population of this country has sprung to 50,000,000. With that enormous growth and still onward movement of population, telegraphy will in all likelihood increase in a still greater ratio, the competition in trade at present being such that no man has a chance of success unless he uses the wires extensively. At the present moment I find that the length of the wires in America is about 400,000 miles, with a capital of some £16,000,000 sterling invested therein, and representing a yearly revenue of £1,420,000. The submarine cables now show a length of 70,928 miles, representing a capital of £28,000,000 sterling, or nearly three-fourths of the value

of the whole of the telegraph system of Europe, and yielding a yearly revenue of £3,000,000. All that submarine system has been created within the past twelve years. The total length of the wires of the world, including submarine cables, is 1,510,592 miles. Their estimated cost is £77,078,162, the estimated revenue being £12,580,481. I hold that this system of telegraphy, which has been so rapidly developed, has brought into connection with each other every centre of civilisation and commerce throughout the world. Its power is so vast in the various departments of politics, commerce, and literature, that those who preside over it are under a great responsibility for its honourable management; and as I have said on previous occasions, the responsibility of being at the head of the power which wields, and more or less conducts the commerce of the world, is a position which it is as enviable to occupy as even that of being President of the United States, great as that honour is (applause). I do not mean to say that the honour is greater than that conferred by the Presidentship, but I refer to the responsibility. In addition to the influence and power at present maintained by telegraphy, I hold it will be largely used in the future in promoting the good feeling which ought to exist between America and the mother country (applause). I would suggest that the press should take a more active part in that direction than they have hitherto done. I have been disappointed when I have taken up the American newspapers to see so little in them about the affairs of England. Seeing that the growth of commerce is so rapid I think the press should arrange matters so as to familiarise the people of America with what is doing in England. It will be my duty when I return to endeavour to get the English press to pursue the same course in regard to American news. I may say that I shall be glad to use the influence that I have in connection with submarine telegraphy to so reduce the expense of the system to the press as to enable them to use it more largely than they have hitherto done (applause). Let me make one remark here in regard to the enterprise of some of our English newspapers. During the war in Africa it was not unusual, nor has it been unusual during the late war in Egypt, for the penny press to expend very large sums upon telegraphy. I remember more than one occasion upon which the penny papers in London have paid as much as £500 for one telegram, showing that they consider it so important to send full and early news that they disregard entirely the expenditure it may entail.

"I have desired above all things in my visit to America to impress upon those in charge of this great power the importance of their trust. There is no system of telegraphy that I have ever seen which is conducted in a more thorough manner, and more with a view to meet all public requirements than that of the Western Union (applause). I may say that it is omnipresent in America. I have found it in the most remote places. I have found it even on the Indian reservations, and there is in every corner of the country evidence that the company is alive to the importance of meeting the demands made upon them by all classes. When I look to the vast territory which their system has developed, and the enormous increase in telegraphy which must arise from that development, I can only congratulate the Western Union upon the position which they occupy, and those who conduct it, for the manner in which they are carrying out their operations (loud applause). As to the treatment which has been accorded me, let me say that I have found those at the head of the telegraph system vying with one another to make my journey pleasant and my path smooth. I have found your telegraph system so thorough that I have been enabled to conduct my business in England almost as easily as if I had been sitting in my office in Old Broad Street, London. As to the different systems of the two countries, that of England is in the hands of the Government, while that of America is controlled by private companies. I must confess that I am not altogether satisfied with the progress that has been made in our system in the ten years during which our system has been in the hands of the Government. We have not had the same scientific development; we have not had the same reduction in rates, or the same extension of system. In short, I do not consider that the Government—that the English Government—have given the facilities to the English people that the Western Union have given to the people of America during that period of ten years. I should, therefore, regret to see that enterprise, which is so energetically carried on, withdrawn from the control of private individuals (loud applause).

GORDON'S ALTERNATING CURRENT MACHINE.

When writing on the subject of this machine last week we omitted certain particulars with which Mr. Gordon had favoured us, thinking that a little extra consideration of the subject would be advisable. We expressed our doubts as to the accuracy of the results obtained by the inventor and his co-workers concerning the efficiency of the machine, which, apparently, gave back in the lamps 94 to 98 per cent. of the indicated horse-power. The following figures of the best result obtained were given to us by Mr. Gordon, who says that the limit of error in taking the indicator diagrams may probably be 5 or 6 per cent. It was found that the steam-engine—which we mentioned as having been employed on board the cable ship *Calabria* for "picking up" operations—when running at 140 revolutions per minute (present normal speed of dynamo-electric machine), and being entirely disconnected from the machine, showed 15 indicated horse-power. When coupled up to the machine, and running at the same speed, with 1,312 lamps in circuit, the engine indicated 143 horse-power (the mean of several diagrams varied from 140 to 147 indicated horse-power). The two Bürgin machines used as exciters are worked, as we have already noted, by a separate engine, and are said to absorb 6 horse-power. Our readers are also aware that Mr. Gordon's tests of the Swan lamps at 21 candle-power give an expenditure of ·1 horse-power absorbed in each lamp. He therefore assumes from these tests, and the observations regularly going on in the photometer room, that the 1,312 lamps represent an electrical horse-power of 131·2, and calculates his efficiency as follows:—Horse-power used in producing the current, 143 — 15 + 6 = 134 horse-power, efficiency then equals $\frac{131 \cdot 2}{134} = 98$ per cent. in the lamps.

In the first place looking at the figures only, we allow that Mr. Gordon is quite justified in subtracting the 15 horse-power indicated by the engine when running free, but he is not right in adding on 6 horse-power for the exciting machines. This does not come into the question, because it is absorbed in the work indicated by the engine driving the large machine. For instance, if we suppose that the electro-magnets of Gordon's machine, which are excited by the current produced by the expenditure of 6 horse-power in the Bürgin machines, could be replaced by permanent magnets of the same strength, then the engine still indicates 143 horse-power to keep 1,312 lamps alight, but we lose sight of the 6 horse-power altogether. Therefore this item should not be brought into the calculation at all.

The horse-power will then be 143 — 15 = 128, and the efficiency $\frac{131 \cdot 2}{128}$ = more than 100 per cent., which is absurd.

Besides the error we have here pointed out, it is more than probable that in many of the Swan lamps the energy expended did not amount to more than half that which Mr. Gordon assumes; and if, as on the occasion of our visit, some of them were actually out, the assumed electrical power of 131·2 expended in the lamps may in reality not be more than 100. No account is taken of the conductors, which, however low their resistance may be, must bear some proportion to the resistance of 1,312 lamps arranged as we described last week. If we take the resistance of two of these lamps in series between the conductors as approximately 80 ohms when at 21 candle-power, then the total lamp resistance (656 sets of 2) will be roughly ·12 ohms, or exclusive of the conductors, about 15 times greater than the internal resistance of the machine.

It will be clearly seen, therefore, that no correct estimate of the efficiency of Gordon's machine can be arrived at until a series of careful tests have been made by several observers. We must, in justice to the inventor, state that he does n

suppose the figures given to us to be mathematically accurate, but he claims that the efficiency of his machine is so high that the difference between it and an ideally perfect machine is nearly covered by the ordinary errors of observation. We may add that the indicator diagrams were taken, quite irrespective of Mr. Gordon's experiments, by the engineers of the Telegraph Construction and Maintenance Company.

ADDYMAN'S FRICTION CLUTCH.

In the description of the Electric Launch which appeared in our issue of October 14th, we made mention of an application of Addyman's Friction Clutch, for throwing in or out of gear either of the two electro-motors used for propelling the vessel. This invention should be of great service to all engineers engaged in putting up the electric light, and, in fact, wherever dynamo-electric machines are employed. The principle of the apparatus is shown in figs. 1 and 2.

The power is exerted by the insertion of the wedge, A, opening out the levers, B B, and thereby expanding the friction ring, C, which grips the shell, D, over its whole surface. This shell runs loose on the shaft when the wedge is withdrawn.

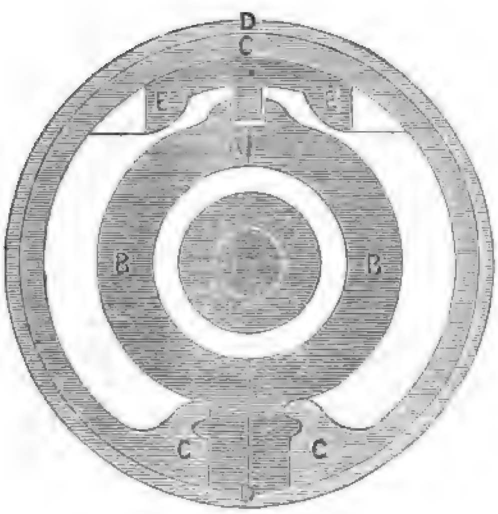


Fig. 2.

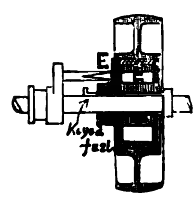


Fig. 3.

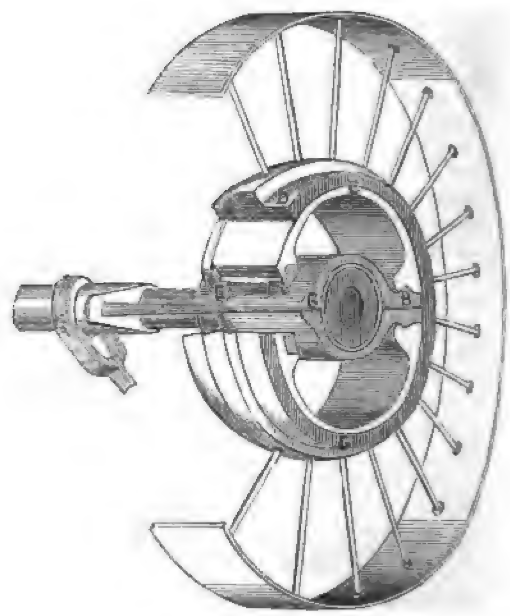


Fig. 1.

The lever actuating the wedge may be worked by hand or by a wheel and screw. When frequent disconnection is required, a simple lever attached to the wedge is all that is necessary.

Fig. 3 shows an arrangement for utilising old pulleys. E E acts as a crank pin to drive the ring C. Fast and loose pulleys which have hitherto been indispensable are now no longer required. Other methods have been devised for accomplishing that which the Addyman Clutch is apparently the best adapted for, but most of them appear to have been defective in their action. Some of the more important engineering periodicals have spoken very favourably as to the merits of Addyman's apparatus, and as far as we have had the opportunity of judging it acts admirably. The manufacturers are Messrs. J. Bagshaw and Sons, of the Victoria Foundry, Batley, Yorkshire, and the clutch has already found its way into the factories of many eminent firms. We understand that the invention has been applied in America for the last ten years, and although it has been known in England for some time past, it has not apparently been prominently brought forward till quite recently.

We are pleased to bring it before the notice of electricians, to whom it might not possibly appear through the ordinary channels of giving publicity to mechanical novelties.

Apropos of the Electric Launch, we may say that Mr. Reckenzaun, the engineer to the Electrical Power Storage Company, is of the opinion that Addyman's friction clutch deserves all that has been said in its favour, and that for electrical work, where the transmission of power through shafts is intermittent, he recommends the apparatus with every confidence.

SPRATT'S ELECTRICAL SIGNALLING APPARATUS FOR COMMUNICATING OUTBREAK OF FIRE.

The systems which have hitherto been in use for signalling to a fire station a notice of the outbreak of a fire in the neighbourhood of a signal post have been generally of one description. The arrangement of the apparatus has been such that the signal given has merely indicated from what post the alarm has been sent, but no means have been provided for enabling any details of the nature or exact locality of the outbreak to be indicated. In Mr. Spratt's system, not only is the usual signalling arrangement provided, but means is also given to the individual who gives the alarm of telegraphing any particulars that may be considered advisable. If the invention of Mr. Spratt consisted merely in the addition of a telegraphing instrument to the ordinary apparatus the idea would hardly be worthy of notice, but the inventor has so arranged all the parts that the ordinary signal and also the telegraphing are both done by the same instrument, so that complication and multiplicity of pieces are avoided. The arrangement of the circuit is such that one battery only is required for any number of signalling posts, whilst means are provided for testing the condition of the wire whenever considered desirable.

The general principle of the whole system is as follows:—At the fire station there is a receiving instrument of the step-by-step type, and at each of the posts there is a step-by-step transmitter. The battery is at the station and the line-wires pass from there to the nearest post, thence to the next, and so on. In the receiving instrument there is an electro-magnet which, each time that the current is completed at either of the posts, attracts its armature. The armature works an escapement, controlling an escapement wheel. The escapement wheel has an index fixed upon its axis, and the reciprocating motion of the armature causes the index to pass around the dial. The dial is marked with the letters of the alphabet, and some other signs, and on an outer circle with the names of the several posts or places. A key is provided for setting the index to zero; it operates mechanically by causing a lever to press upon a cam on the same axis with the index.

The first movement of the armature, by shifting a small finger or lever, closes a local circuit in which a bell is included, and the bell sounds. The zero key also acts on

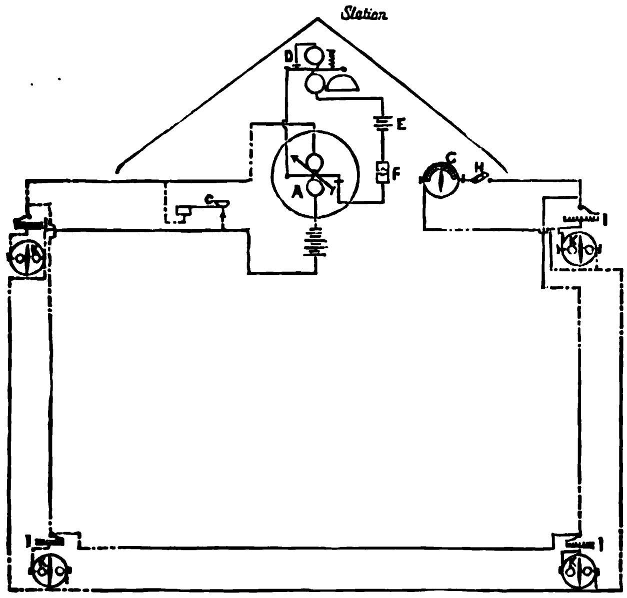


Fig. 1.

this finger to open the circuit at the same time that the index is set. There is also a plug circuit closed in the local bell circuit, and the bell can be silenced when desired by withdrawing the plug. The battery which works the whole system is, as already stated, at the central station, and here also a finger-key is provided which, when depressed, closes the circuit at the station, and takes the battery off the line, and so, as will be explained, indications can be given to the operator at the post.

The transmitting instrument at each post consists of a revolving contact-maker with the proper number of contacts to correspond with the receiving instrument; so that a complete revolution of the transmitting handle, or wheel, produces a complete revolution of the index on the dial. Each contact made by the transmitting instrument closes the circuit momentarily, the circuit normally (or when the instrument is at rest) being open.

This revolving contact-maker is so arranged that it can either be turned by hand from letter to letter, or it can be actuated by the pulling out of a stop, which causes the contact-maker to revolve the distance required to move the index at the receiving station until it points to the name of the post which signals. Thus the operator at the central station knows where the fire call comes from.

For verbal communication the contact-maker is moved round by hand, step by step, to the letters it is desired to transmit.

In one position in which the contact-maker can be placed, the circuit is closed through a galvanometer, the needle of which consequently deflects.

At the same time the position of the index at the station will show to the operator there that he can communicate with the post, which he does by depressing his key.

Each time that he does this the galvanometer needle will fall back, there being then no current on the line or through the galvanometer coils. In this way any prearranged signs may be given, and information, if necessary, conveyed by the Morse code.

Fig. 1 shows the general arrangement and combination of the apparatus for connecting a district with a fire station. The instruments at the station are indicated, also those at four outlying posts.

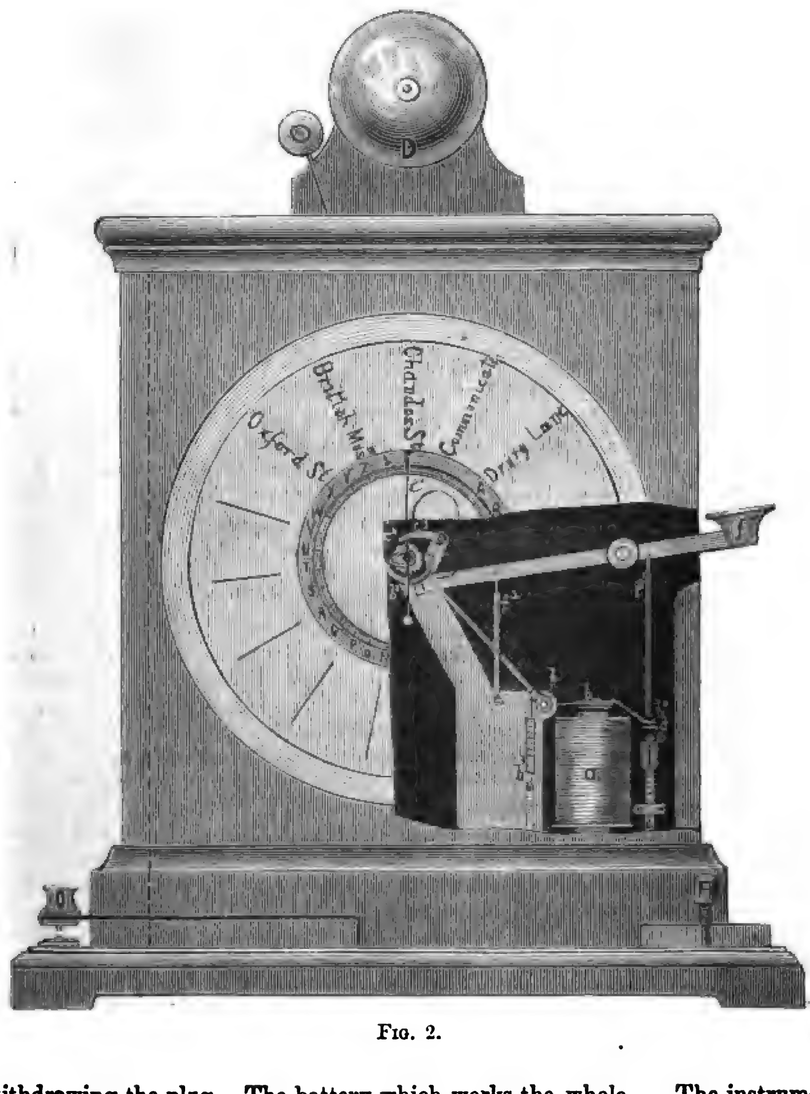


Fig. 2.

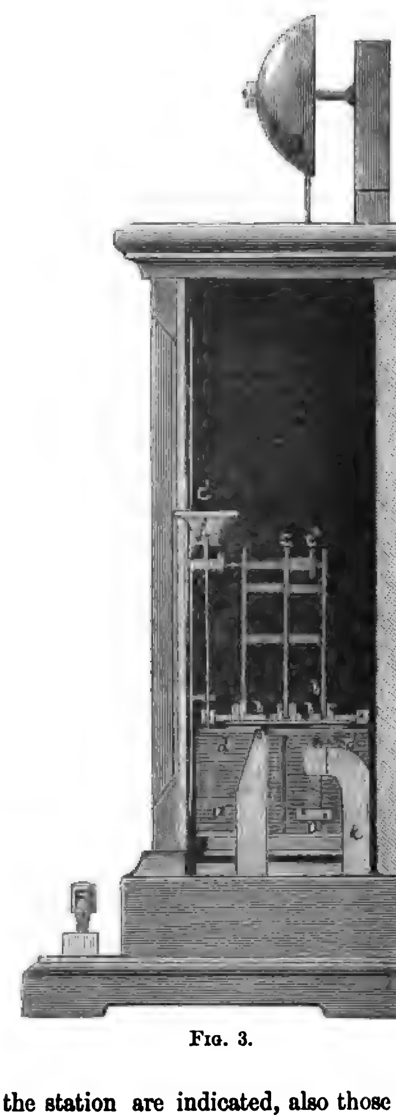


Fig. 3.

Fig. 2 is a front elevation, partly in section of the step-

by-step receiver at the station. Fig. 3 is a side elevation, also partly in section of the same.

Fig. 4 is an elevation, partly in section of the instrument at a call post. Fig. 5 is a plan of the same.

In fig. 1 A is the step-by-step receiver, B the main battery, C the short-circuiting key, D the bell in a local circuit, E the bell battery, and F the plug socket. At the station there is also a testing galvanometer, G, and a switch, H.

At each post there is a rotary circuit-closer, *i*, which in a complete revolution carries the index of the step-by-step receiver completely around the dial.

The current from the main battery when the circuit is closed passes through the coils of the electro-magnet in the receiver, out to the posts, and back from any post at which the circuit is closed, to the battery. The circuit can also,

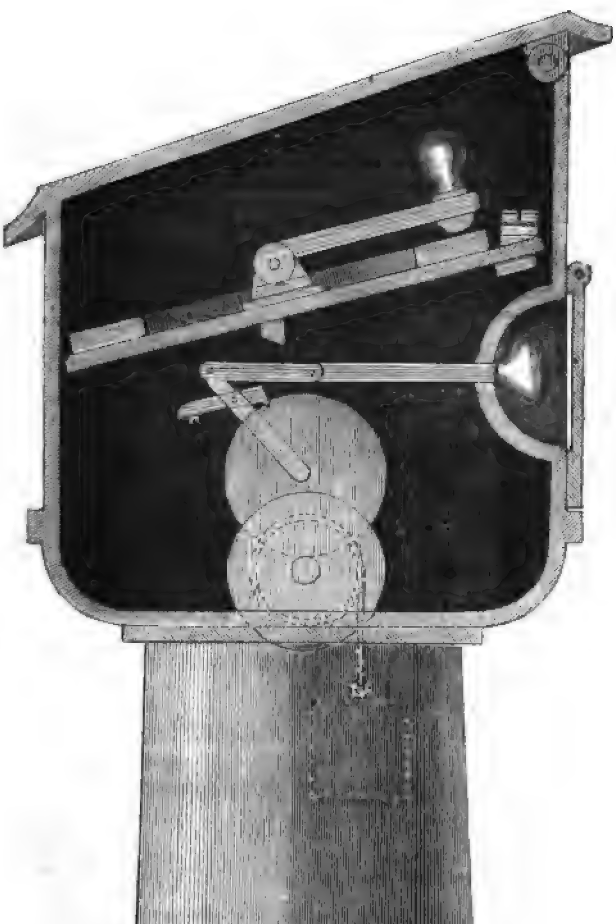


FIG. 4.

when desired, be closed in the station by the switch, H, and then the deflection of the galvanometer, G, will show that the circuit is complete throughout. When the circuit is completed at either post the operator at the station can nevertheless take the battery off the external part of the circuit by depressing the key, C; this he does for the purpose of communicating with the post in the manner to be described.

The local bell circuit is normally open, but it is completed by the first movement of the index of the receiver and remains complete until the index is replaced by the attendant. The bell can be silenced by removing the plug at F; this is necessary when communicating from the station to a post.

In figs. 2 and 3 *a* is the electro-magnet of the step-by-step receiver and *b* its armature. The armature, *b*, is carried ... the shorter arm of a lever pivoted at b^1; the longer arm of the same lever carries an anchor, b^2, which, during the to-and-fro movements of the armature resulting from the attraction of the magnet and the reaction of the spring, b^3, serves to propel the ratchet-wheel, *c*. The wheel, *c*, has as many teeth as there are signs upon the dial around which it carries the index, c^1, this index being mounted upon the axis of the wheel. To give greater certainty to the movement a ratchet-wheel, c^2, is provided on the same axis. This wheel has double the number of teeth of *c*, and with it the light spring pawl, c^3, engages. $b^{\times}$ is a projection from the armature-lever which, when the armature is attracted, comes down upon the light lever, *d*, and causes it to make contact with the point, *e*. The bell circuit is then completed, through the standard, d^1, upon which the lever, *d*, is carried, through the pivot, d^2, of the lever, through the point, *e*, and through the standard, e^1, which carries the contact point.

f is a finger key which has two duties to perform, viz., to set the index, c^1, to the zero mark, and simultaneously to sever the contact between the parts *d* and *e*. It effects the latter by means of the stem, f^1, which, when the key is depressed, strikes upon the lever, *d*, and raises the end of it, by which contact is made. d^1 is a small insulated spring, serving to retain the lever, *d*, in either of the positions which it has to assume. f^2 is a spring for returning the finger key, *f*, when it is released. The index, c^1, is brought to the zero mark by the following means :—it is not fixed upon the axis of the wheel, *c*, but is carried upon a tube, which em-

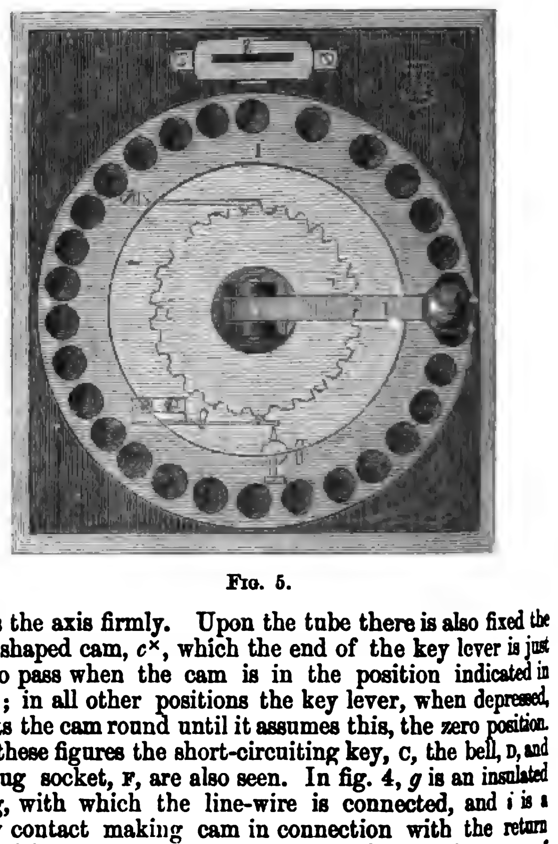


FIG. 5.

braces the axis firmly. Upon the tube there is also fixed the heart-shaped cam, $c^{\times}$, which the end of the key lever is just able to pass when the cam is in the position indicated in fig. 2; in all other positions the key lever, when depressed, thrusts the cam round until it assumes this, the zero position.

In these figures the short-circuiting key, C, the bell, D, and the plug socket, F, are also seen. In fig. 4, *g* is an insulated spring, with which the line-wire is connected, and *i* is a rotary contact making cam in connection with the return wire. The contact cam, *i*, can be turned round by means of the jointed handle, i^1, or, as will be seen, it can be rotated by withdrawing a draw knob, *o*. The projections on the cam, in passing the contact spring, touch it, and for each projection a current passes in the line-wire, causing the index of the receiver at the station to move a step. The handle, i^1, has a hemispherical projection on the under side, and there are holes of a like form arranged in a circle around the handle; these holes each correspond to a letter or sign, and to indicate this letter or sign on the dial of the receiver the handle is brought to the hole, and depressed so that the projection may enter; thus it is insured that the handle is brought accurately to the proper place. In all these positions, excepting one, the projections of the cam are out of contact with the spring, *g*. The remaining position is that to which the operator sets the handle when he desires to communicate.

The main circuit is then closed through the contact cam, *i*, the spring, *g*, and the coils of the needle indicator, K, the needle, K, is consequently deflected, but it falls back when-

ever the operator at the station puts down the key, C, for the battery is then taken off from the line. Thus communication is made from the station to the post. The coils of the needle indicators, K, are so wound that at whichever post the circuit may be closed, the resistance to be worked through may be approximately the same; this is effected by giving a higher resistance to the indicators which are near to the station than to those which are more distant, in such proportion as to compensate for the difference in the lengths of the line-wires.

The pull, *o*, when drawn out operates upon a pawl lever, and this engages with a wheel with a notch in its periphery. When the pull is withdrawn to its full extent the tail of the pawl strikes against a stop, and causes the withdrawal of the pawl from the notch. The axis of the wheel is geared to a wheel and pinion with the axis of the barrel on which the cord, *l*, is wound. Each operation of the pull winds the cord around the barrel, and when the release of the pawl takes place, the weight runs down and causes the barrel to revolve back. The barrel is geared with the contact cam, *i* (which is connected to the handle, i^1), by means of a ratchet wheel, so that *i* is only turned when the barrel rotates back under the influence of the weight. By giving a different angular movement to the cam, *i*, at each post, the number of contacts which will be transmitted can be varied so that the indication of the step-by-step indicator will show from which post the signal has been transmitted.

Although the arrangement described works on the open circuit system, Mr. Spratt has arranged so that it can be made, if desired, to operate on the closed circuit principle. As is well known, there is a very general opinion that for alarm systems the closed circuit principle is decidedly preferable to the open circuit one; we are rather inclined to think that this opinion is somewhat too strongly insisted upon, but nevertheless, as it must have considerable weight, any new alarm system brought out at the present time would have a much better chance of success if it worked in accordance with the general idea of what is the correct method.

OBITUARY.

We regret to have to announce the death, at the comparatively early age of fifty, of Mr. Joseph Christopher Laws, which occurred at Brighton on the 26th ult.

Born May 31st, 1832, at Brighton, and educated at Lancing College, he was apprenticed to a watchmaker in his native town, where he learned that which assisted him so much in after years, viz., practical mechanics.

He came to London as assistant to Mr. Whitehouse in 1854, and was engaged in the laying of the first Atlantic cable in 1858. In 1859 he entered the service of Messrs. Gisborne and Forde, the engineers for the Malta and Alexandria cable. His next engagement was with Messrs. Bright and Clark, assisting in the manufacture and laying of the Persian Gulf cables; and from this service he entered that of Messrs. Clark and Forde, during which time he was engaged on cable expeditions in various parts of the world. In 1869 he was employed by the Telegraph Construction and Maintenance Company to assist Mr. Willoughby Smith in the electrical department on board the *Great Eastern* whilst submerging the French Atlantic cable between Brest and St. Pierre, and he remained in the company's service till the day of his death. During this time he was in charge of the electrical department on board ship throughout the laying of most of the cables manufactured and laid by the company. For the last two years he held the post of head of the electrical staff at the Greenwich Works. Mr. Laws was one of the early members of the Society of Telegraph Engineers.

He was interred in Highgate Cemetery on 31st ult., and the large number of friends who assembled to pay the last tribute to his memory gave evidence of the great esteem and regard in which he was held not only by those who were fortunate enough to be intimately acquainted with him, but also by those who had the pleasure of being associated with him in business. His disposition was of a retiring nature; and had he been a pushing man like some of his contemporaries he would doubtless have stood before the world in a more exalted position than he did. He was a most conscientious and painstaking worker, and probably there is but one other electrician living with a like knowledge of all matters appertaining to submarine cable manufacture and laying, to that possessed by Mr. Laws.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," Electrical Review, at above address.

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CORRESPONDENCE.

RE JOHN FULLER AND SONS' NEW PRICE LIST, PAGES 22 AND 33-4.

To the Editors of The Electrical Review.

Sirs,—Daniell has a potential of 1·14 volts, Bichromate has a potential of 2·08 volts (ratio as 1 : 1·82).

10 Daniells have a potential of $1{\cdot}14 \times 10 =$

$11{\cdot}4$ volts $\therefore \frac{11{\cdot}4}{2{\cdot}08} =$ say, 5·4 instead of 3

$\therefore$ to equal 10 Daniells 5·4 bichromates

are needed. $5{\cdot}4 \times \frac{15}{3}$ shillings = ...	£1	7	0
20 per cent. for coloured statement, say—	0	5	0
	£1	12	0
While 10 Daniells, as per coloured statement for trade purposes	£1	2	4
So that the cost of bichromate without cells or carbon plates, less cost of Daniell as against bichromate = ...	0	9	8

As to pages 33 and 34 of the price list, Mr. (afterwards Sir) Wm. Fothergill Cooke used, for many years before and after 1847, sulphate batteries on the Blackwall Railway to work the telegraphic communication between the engine houses, and this was virtually block signalling. The batteries were made of copper plates in parchment cells filled with sulphate of copper, the zincs being in water. Troughs were made of teak wood divided by slate partitions, and the whole coated with marine glue. The inventor of the gravity battery was Mr. Varley.

JAMES B. SPURGE.

Romford, *October 25th*, 1882.

[We have not yet had the pleasure of perusing the price list mentioned by our correspondent.—Eds. Elec. Rev.]

INDUCTION.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In the *English Mechanic* of November and December, 1879, I pointed out and described the phenomenon known as double induction; I also stated there that double induction takes place in almost all electro-dynamic machines, both when used as generators and as motors, the phenomenon is, however, most marked in the Weston electroplating dynamo, the De Méritens and Gramme alternate current machine.

I don't know if any one observed this interesting effect previous to my experiments in 1879. I may at some future time detail these experiments and give their results, some of which are quite inexplicable under any of the crude theories as yet advanced to explain the action of armatures under induction in electro-dynamic machines.

I am yours,

RANKIN KENNEDY.

Glasgow, *October* 30*th*, 1882.

THE HEATING EFFECTS OF ELECTRICITY.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Certain notions have presented themselves to my mind regarding the cause of the diminution of currents of electricity, on account of the resistance which this effect encounters in its passage. I send these ideas to you in the hope that they may possess sufficient novelty to warrant their publication through your valuable medium.

It is well known that friction produces heat in a greater or smaller degree, according as the motion of bodies is rapid or slow; and that the greater the resistance offered to a force, the greater will be the friction.

It is also generally known that heat always exists during the flow of an electric current, in a greater or smaller degree, and in a like manner that there are no perfect conductors, *i.e.*, all conductors offer a certain amount of resistance to the flow of the current.

Now suppose a current to be flowing along a conductor of small resistance. The resistance to the passage of the current being slight, the friction (*i.e.*, the power exerted by a certain force in overcoming another force) would be small, and there would likewise be little heating effect.

Again, suppose a current of the same dimensions to flow along a conductor of great resistance. The resistance, or force to be overcome by the current, being greater, the friction is also greater, and in like manner the heating effect is more perceptible; but the strength of the current will be found to be considerably less than in the previous instance.

Does not energy, imparted to a body, always expend its force in some form or other? Also, does not the current always decrease in quantity by its flow along a conductor, in a greater or smaller degree?

Therefore, I conclude that the decrease in the strength of the current of electricity, due to the friction in encountering the resistance offered by the conductor, is due to the fact that the missing portion of the current has, by reason of friction, expended itself along the conductor in the form of heat.

Apologising for taking up so much of your space,

I remain, dear Sirs, faithfully yours,

F. W. F.

[We insert our correspondent's letter as it apparently shows an inquiring spirit, but he evidently has not studied the subject deeply, or he would know that he has advanced nothing new.—EDS. ELEC. REV.]

ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—As your columns are open to all matters connected with electric lighting, I take the liberty of giving you an explanation of the state of affairs at St. Enoch station, Glasgow, which, I believe, was the first railway station lighted by electricity in Great Britain.

Some three years ago—acting for the British Electric Light Company—I succeeded in inducing the directors of the Glasgow and South Western Railway Company to adopt electric lighting, and, as they had an engine on the premises, constructed for driving the machinery of the laundry of their hotel, it was arranged that this engine should be used for the purpose of driving the Gramme machines.

I pointed out at the outset to one of the directors of the railway company that the engine was not only sufficiently powerful to drive the machines, or even double the number, but that I feared that the engine main-driving belt would slip upon its countershaft pulley, when I was met with the remark that the arrangement would be but a temporary one, and that if the lights gave a fair degree of satisfaction the company would erect a special engine.

At this time four A Gramme and four Serrin lamps were used, and were of course found to be insufficient for lighting a station 500 ft. long, 205 ft. wide, and about 90 ft. high, so it was afterwards arranged to increase the number of lights to six, and instead of using the Serrin lamps I set up six of Crompton's lamps, and after running them for one year they were thrown out for reasons which I need not here explain. Brockie's lamps were then introduced, with occasionally very marked improved results, but these results have been as variable as the weather, the cause for which I shall have no difficulty in making perfectly plain to any ordinary mind.

During the daytime the engine is used for laundry purposes alone, and is driven to 78 revolutions per minute, the countershaft making 104 revolutions. At night when the Grammes—as well as laundry—are in use, the engine speed is raised to 88 revolutions, and of course the countershaft speed should increase in proportion, whereas it is a fact that it has been making but 104 to 105 revolutions, the slip of belt giving a decreased speed to the Grammes of about 140 revolutions per minute.

It is also a fact that when the engine has been driven to 95 revolutions, the countershaft makes only 105, and of this I have from time to time complained to the railway company, but their engineer would never admit it, nor would he tighten his belt until within the last three weeks, since which the lights have been giving the greatest satisfaction; but whilst this mere temporary arrangement has given the requisite speed for the Grammes, it cannot be relied on.

I need not explain to you what shortness of current means in the working of an electric plant, and as the railway company will not see the necessity of providing proper driving arrangements, after their repeated promises, the British Electric Light Company have determined to withdraw their plant, and on Tuesday night, the 31st instant, the electric lighting of the station by this system will cease.

I am, Sirs,

Yours obediently,

JOSHUA HORTON.

134, St. Vincent Street,

Glasgow, *October* 28*th*, 1882.

ELECTRICAL TRICYCLE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your last number you favoured your readers with the news of an experiment made with Messrs. Ayrton and Perry's tricycle. The subject of road locomotion by electric energy is of immense interest to all classes. I venture, therefore, through your columns to ask Prof. Ayrton to enlighten the public with fuller particulars concerning this "invention." How many cells do they use to drive their motor, what current and electromotive force, how many hours will the vehicle run on a level road—at what speed, when once charged? What may be the weight and actual power of their motor, what kind of gearing is used to run at any reduced speeds?

A sketch in your valuable paper would prove most instructive. Since the machine has already been exhibited in the streets, there cannot be any further secret about these details. Yours obediently,

A. RECKENZAUN, C.E.

October 30*th*, 1882.

ELECTRICAL TRICYCLES.

To the Editors of The Electrical Review.

Sirs,—What is the use of an electric tricycle? The Locomotives (Roads) Act, Section 3, enacts that "every locomotive propelled by steam, *or any other than animal power*, on any turnpike road or public highway, shall be worked according to the following rules and regulations amongst others, namely: Firstly, at least three persons shall be employed to drive or conduct such locomotive; secondly, one of such persons while any locomotive is in motion shall precede such locomotive on foot by not less than 60 yards, and shall carry a red flag constantly displayed, and shall warn the riders and drivers of horses of the approach of such locomotive, and shall signal the driver thereof when it shall be necessary to stop, and shall assist horses, and carriages drawn by horses, passing the same." And by Section 4, the speed at which such locomotives shall be driven along a highway is limited to four miles per hour, and through a city, town, or village to two miles per hour. Is this how electric tricycles are proposed to be driven? That a tricycle *is* a locomotive within the meaning of the Act of Parliament if driven by other than animal power has been recently decided by the Queen's Bench in the case of Parkyns *v.* Priest, 7 Q.B.D., 313.

Yours, &c.,
CHANCERY LANE.

October 31*st*, 1882.

SECONDARY BATTERIES AS CURRENT REGULATORS.

To the Editors of The Electrical Review.

Sirs,—The interesting letter given in your last week's paper from Mr. C. H. Farquhar shows with what safety and regularity electric supply can be effected by the assistance of storage batteries, and undoubtedly a distribution of electrical energy without accumulators will soon become obsolete.

Your correspondent is perfectly right in attributing no novelty to his experiment, the introduction of secondary batteries in a system of supply having been patented by Mr. Lane-Fox as far back as 1878, in the specification of which patent the power of these to regulate the supply is specially referred to, in addition to their function as reservoirs.

Your obedient servant,
W. H. C.

27, Norfolk Road, Regent's Park,
October 30*th*, 1882.

SECONDARY BATTERIES.

To the Editors of The Electrical Review.

Sirs,—As much has been said in your valuable journal from time to time regarding secondary batteries, a few remarks from me may be interesting, if not instructive, to some of your readers.

In the early days of the Faure accumulator I was led, as were many others, to try some experiments in this direction, but soon found that there were many difficulties to contend against, the chief of which seemed the formation of the insoluble and badly conducting sulphate of lead on the plates, and in trying to eliminate this evil it occurred to me that if a more oxidisable metal were substituted for the spongy lead as a positive or generating plate that the electromotive force would be considerably augmented, and at the same time the formation of $PbSO_4$ be prevented. I accordingly tried an amalgamated zinc plate and a strong solution of sulphuric acid, and short-circuited the cell for a few days, the result being, as might have been expected, the formation of $ZnSO_4$ in solution and complete reduction of all lead oxide and sulphate to the spongy metallic state. The cell was now slowly charged with a current only just sufficient for the purpose, zinc being redeposited on the zinc plate, and a thick coating of pure peroxide formed on the lead.

On being tested the electromotive force was found to be considerably greater and the current more constant than with two lead plates, and when at rest no plumbic sulphate was formed.

Yours faithfully,
F. W. COOKE, A.S.T.E. and E.

Telegraph Department, G.N.R.,
Retford, *October* 31*st*, 1882.

NOTES.

Notice to Readers.—Subscribers are hereby notified that in future the supply of back numbers of the Electrical Review cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

Electro-motors.—We are informed by our Paris correspondent that in our description of the Jablochkoff motor an omission occurs. In reality, there exist two forms of the Jablochkoff motor. The first, that which we described last week, and which the illustration represented, is composed of a revolving bobbin with a core of iron in which the current is reversed, and of a fixed coil without iron, which the current always traverses in the same direction. It only bears two brushes. The second form, the most recent, has four brushes; the current traverses the revolving bobbin always in the same direction, and is reversed at each half-revolution in the fixed helix. It is in this last form that are found the advantages of the suppression of the magnetic masses in the parts which alter with the direction of the current in consequence of the complete suppression of the detrimental effects due to the magnetic inertia: the principle of its action is thus identical with that of the Bürgin motor. The motor, however, which is now in London is of the form we have already described. It may be interesting to compare an invention of M. Rapieff, which was patented in 1879, with that of M. Bürgin. We described in our issue of May 1st, 1880, one of the numerous dynamo-electric machines devised by M. Rapieff, and which he states in his patent may be also used as an electro-motor. The two are practically identical.

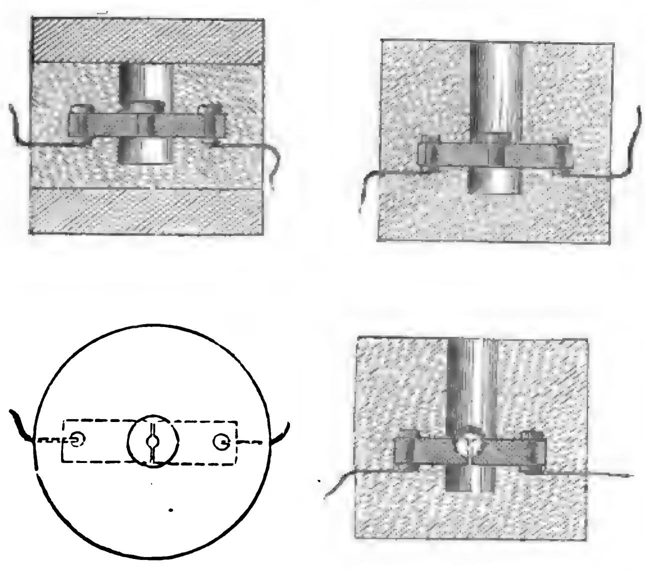
Partnership Notice.—Mr. E. J. Paterson, the well-known electrical apparatus manufacturer, informs us that he has taken into partnership Mr. Charles F. Cooper, who for many years was connected with the celebrated engineers, Messrs. J. & H. Gwynne, of Hammersmith.

The Telephone in the Fire-alarm Service.—The municipal authorities of Darmstadt, after a prolonged examination of the various apparatus for signalling the outbreak of fire, have decided upon the exclusive use of the telephone for this purpose. The Bell-Blake system has been selected as the most suitable for this purpose. A set of telegraph wires, including the whole town, is to be constructed and so arranged that the central office can communicate with every station singly, or with all at once. The apparatus will be supplied and erected by the Berlin firm, Armin Tenner.—*Electrotechnische Zeitschrift.*

Experiments in Telephony.—The following tests of the Lockwood and Bartlett Telephones have recently been made by Mr. Waterbury, in America, and were designed to ascertain the limit at which good commercial talk could be assured with the ordinary style of instrument. He obtained from a telegraph company permission to use two of the thirty line wires which leave their office at the place where the tests were made, between the hours of two and four p.m., a very busy part of the day. The first trial was to a town, distant by wire ninety-six miles from the main office, where he and Mr. Bartlett were stationed. The experiment was begun by using a "ground circuit." Conversation was easily carried on with others at the other end of the line, the words being conveyed clearly and distinctly; the induction was hardly perceptible. A "metallic circuit" was then used, and it gave excellent results. The test was continued for about an hour, and during the time a severe thunder storm prevailed all along the line. By directions which were communicated to Dr. Waite (who was assisting) through the telephone, he went forward to a town one hundred miles beyond that in which he was first stationed. At two o'clock on the following day the tests were resumed; this time the stations were one hundred and ninety-six miles apart. Conversation was

carried on as before, and good commercial talk was had both with "ground" and "metallic circuits." Scarcely any induction noticeable. The severity of these tests will be apparent when it is considered that the wires used ran on the same poles with from fifteen to thirty others. Ordinary telegraph wires were used, which neither in construction or connection had been intended for telephone service. A trial was then made over three hundred miles of wire, under like conditions and with the same instruments, at which words and parts of sentences were sent and heard and understood. As a result, Messrs. Waite and Bartlett are now in possession of data which will enable them to construct a form of telephone especially for long distance service, or for over two hundred miles. Speech was transmitted at these tests, under the difficulties which have been enumerated, as clearly and distinctly as by the Bell telephone for short distances and on lines constructed especially for telephone service.

Transmitter for Telephone.—Reissue. Patent No. 10,183. Filed in the United States of America Patent Office, April 8th, 1882, by Robert M. Lockwood and Samuel H. Bartlett. Original No. 228,826, dated June 15th, 1880.



Claim.—1. A microphone transmitter for telephones, consisting of electrodes combined with a block or support of cork or equivalent non-resonant material, substantially as described, whereby said electrodes are covered or protected from the direct action of atmospheric sound-waves, said waves impinging upon the surface of and being transmitted through said non-resonant material to the electrodes, substantially as specified.

2. Plates or bars of carbon or other conducting material arranged with their adjacent sides or ends out of contact, and having their opposite ends firmly supported in a non-resonant material, in combination with the interposed button, arranged and operating substantially as described.

The Telephone and Fire Alarms.—About a fortnight since, fire was discovered to have broken out in a wooden erection within the fish-curing yard at Point Law, Aberdeen, leased to Mr. T. Ross, fish-curer, Lossiemouth. Immediately on the discovery of the fire, information of the occurrence was communicated to the City Police Office from the dock gates by means of the telephone, which was introduced into the latter place some time ago. On the receipt of the intelligence at the Police Office, the telephone there, which is also connected with the houses of the inspector and the captains of the brigade, was put in operation in summoning them. The call was most effectual, for in less than five minutes the whole of the captains, five in number, were at the Central Station. It should be added that this is the first time that the telephone has been used since its introduction into the police offices for the purpose of summoning the Fire Brigade.

Gas *v.* Electricity.—The explosion of gas which occurred at a recent committee meeting of the Mile-End Vestry, just as the question of lighting the main road and other portions of the district by means of electricity was being discussed, does not require much comment. It is, however, highly probable that the vestrymen to the number of nearly a dozen who suddenly found themselves under the table, will vote in favour of the electric light.

Electric Light for Hell Gate.—At a regular meeting of the Lighthouse Board of Washington, U.S.A., on the 13th ult., a report was received from the special committee on the lighting of Hell Gate by electricity, recommending Hallett's Point as the best available site for the electric light tower; also suggesting that the tower be constructed of iron, with a height of 250 feet, and to contain lights of 20,000 candle-power, which are to be displayed from sundown to sunrise. The report was adopted, and it was ordered that the necessary plans and specifications for the tower and machinery be prepared at once at the office in this city. It was also decided that all the machinery to be employed in this tower be duplicated, so that in case of accidents to any part of the machinery it can be replaced.

The Dangers of Electric Lighting.—A prominent American electrician has recently given a New York *Herald* representative the following account of the fearful havoc which a "Brush" dynamo-electric machine is capable of producing. "Electricity," says the prominent electrician, "as generated in this system might be used with frightful effect as a defensive measure in time of war. Suppose I had in a fort a steam fire engine, with a hose that would throw a stream of water, a quarter of an inch in diameter, 300 feet. Now, if I had one end of a Brush machine grounded and the other end connected with the water passing through the hose, the very instant the stream of water struck a line of troops that were advancing to attack the fort it would kill them. The stream would then be really a flexible electric wire, and as it swept along the line of men it would mow them down like grass. If a thousand men were to march up in a solid body they could all be killed in ten seconds. It would be absolutely impossible to take the fort. It could be used with equally terrible effect in naval warfare. As soon as you make war so destructive as that, however, civilisation will do away with it."

We have oftentimes alluded to the danger to human life involved in the use of high tension currents, but we had never dreamed of the extent to which this mischief might be carried by ingenious Americans. We should be inclined to think there might be something in this novel application of electricity, did we not know that a column of water 300 feet long and only a quarter of an inch in diameter, has a property called resistance. Still the addition of a little sulphuric acid would improve its conductivity, and it might be well to insulate the engine to prevent the current passing down the water column inside the hose instead of flowing externally, and—what if soldiers wore rubber shoes? But it is not for us to suggest improvements, the whole idea is quite too original.

Electric Lighting.—Several additional lamps have been added to the galleries and corridors of the Dundee Fine Art Exhibition.

The Northern Electric Light, Power and Appliances Company, Dundee, have just concluded a contract with Messrs. P. & D. Campbell, dyers, Perth, to light a portion of their dye works with a combination of arc and incandescent lamps.

The Leith Town Council have received a number of notifications from electric lighting companies of their intentions to make application for the necessary Provisional Order. They have been reserved for consideration.

At a special meeting on Monday the Town Council of Paisley unanimously resolved to apply to the Board of Trade for a Provisional Order to supply electricity for the public and private lighting of the town, in terms of the Electric Lighting Act, 1882. It was explained that this step was for the purpose of keeping private companies out of the burgh.

In their report to June last, the directors of the Eastern Electric Light and Power Company (Limited) refer to the prohibition of illumination by means of overhead conductors as preventing the acceptance by the company of contracts, but adding that the Government have intimated that they will be prepared to adopt for India similar provisions to

those contained in the Electric Lighting Act of 1882, and to give similar facilities.

ON Tuesday two deputations—one from Birmingham and the other from Sheffield—waited upon the President of the Board of Trade with reference to the subject of electric lighting. The object of the deputations was to point out the difficulty in which they, as undertakers, were placed while desirous to prevent any company or person obtaining a monopoly by holding a Provisional Order of the Board of Trade. Mr. Chamberlain, in replying, said that if the local authorities could not undertake the work themselves they must, in their own interests, endeavour to make some arrangement with an electric lighting company. It was impossible for the Board of Trade to postpone the issue of Provisional Orders. The Electric Lighting Act did not contemplate monopoly on the part of any one, and in the event of a public company obtaining a Provisional Order, and not satisfactorily carrying out the lighting arrangements of a locality, the Board of Trade would be prepared to consider any application from the local authority, or other body, for a second Provisional Order.

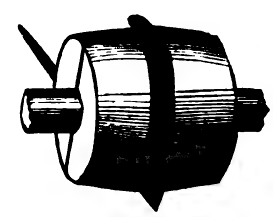
THE 21st of December has been appointed by the Board of Trade for applications to be made for Provisional Orders under the Electric Lighting Act, but licences may be applied for and granted after that date.

CENTRAL LIGHTING STATION AT MIDDLESBROUGH.—The Yorkshire Brush Electric Light and Power Company, Limited, have just opened a central lighting station on the West Marshes, Middlesbrough. This station is for the purpose of supplying the electric light, both arc and incandescent, to the various ironworks, which form the staple industry of the district, and which are here grouped together in a comparatively small area. A substantial brick and iron building has been erected, and accommodation provided for an almost unlimited number of lights. The present plant consists of a twenty horse-power, semi-portable, compound engine, by John Fowler & Co., Leeds, driving a No. 8 Brush machine, or what is commonly known as a forty lighter. This plant, however, is only for temporary purposes, and it is intended to put down fixed engines of the most approved type whereby there may be a constant supply of electricity for several hundred lamps. The area it is proposed to light comprises about three square miles. A very successful start was made on the 22nd inst., when the lighting was commenced at the North Eastern Steel Works.

MR. J. BANTING ROGERS ON THE ELECTRIC LIGHT.—Mr. J. B. Rogers, of the J. B. Rogers' Electric Light and Power Company (Limited), 47, Holborn Viaduct, has written a pamphlet on "The Commercial Prospects of Electric Lighting in Combination with Gas Companies." The highest praise which we can bestow upon this badly-worded pamphlet of 15 pages is that it is worthy of the inventor of the system of *division* and *sub-division* of that "wondrous subtlety Electricity," which we had fondly hoped the world had heard the last of. Mr. Rogers deems it necessary to show himself now in his true colours, and as we believe the pamphlet will be forwarded on application, its readers can study Mr. Rogers as painted by himself. His speech at the meeting of the J. B. Rogers' Company, which can be seen in the pages of the ELECTRICAL REVIEW this week, may be taken as fairly indicative of this literary effusion.

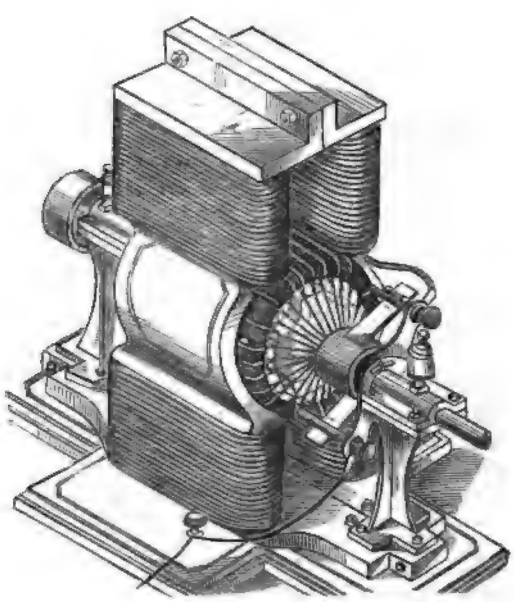
THE "PILSEN" ARC LAMP.—The fancy fair at Belfast was lighted last week by four "Pilsen" lamps. We understand this to be the first introduction of the system into Ireland, and the steadiness of light compared with other lamps caused much comment. Messrs. Woodhouse & Rawson were the contractors.

INSULATORS AND SUPPORTS FOR ELECTRIC LIGHT WIRES.—The sketch above illustrates a neat and simple form of earthenware insulator for holding fast electric light wires in factories, tunnels, or along walls generally. It is manufactured in such a way that by the insertion of a knife-blade into a crevice, which is left all round it, the insulator divides into halves. The wire can then be laid in one half, and the other closed over it, and all may be made firm and securely attached to any supporting body by driving in a



gas-hook, as shown. The patentees are Messrs. Woodhouse & Rawson, and doubtless their cheap and simple device will prove of service in electric light installations.

DYNAMO-ELECTRIC MACHINE.—Patent No. 262,544, filed in the United States of America Patent Office, by James A. Jenney, April 15, 1882.



Claim.—1. The combination, in a dynamo-electric machine, of four electro field-magnets, which, with their connecting-plates and field-segments, are made in two solid continuous masses of iron, so formed and joined in a plane passing either vertically or horizontally through the centre of the armature-axis that the field-magnets in such casting shall be in line with each other and in the two castings parallel with each other, and which are wound with their field-coils in such directions that the two magnets in each casting shall have their similar poles joined in the field-segment connecting them, and that the two field-segments shall be of opposite magnetic polarity with respect to each other, said two castings to constitute, when joined and bolted together, the entire iron framework of the machine, exclusive of the armature and its mounting, with a cylindrical soft-iron armature, smooth and uniform in thickness in surface, mounted and revolving between the field-segments aforesaid, upon an open skeleton or framework of wood and brass or other non-magnetic material, adjustable in all directions from its central axis, the whole constructed, combined, and operating substantially as described and set forth.

2. In a dynamo-electric machine, a skeleton or framework for the mounting and carrying of a cylindrical iron armature, consisting of two hubs, made of brass or other non-magnetic material, with radiating arms of like material, adjustable in length by being set as screws into their hubs, and supporting at their extremities wooden bars pressing against the inner surface of the armature, substantially as described and set forth.

THE INTERNATIONAL ELECTRICAL CONFERENCE.—We read that the International Conference for determining Electrical Units, which has been sitting in Paris for the last fortnight, has, after passing several resolutions, adjourned to the first Monday of October, 1883. In closing the conference, M. Cochéry, the Postal Minister, assured the members that the French Government would endeavour to give effect to their resolutions by representations to the various Governments concerned. It is hoped that the twelve months for which the Conference is adjourned will be sufficient for the searches in the various departments in question to be completed.

The French Cable Company.—The special committee of the Board of Trade and Transportation of New York, to which was referred the question of ocean cable rates and of the disregard by the French Cable Company of its stipulations entered into with the Government of the United States, presented the following report, through Mr. F. B. Thurber, one of its members :—

On the 16th of July the House of Representatives, at the instance of Mr. Cox, of New York, passed a resolution calling upon the President for any information in possession of the Department of State relating to any change or modification in the stipulations which the French Cable Company made with our Government on the 19th of February, 1880. The State Department was very dilatory in furnishing the information, and it only came on the eve of the adjournment of Congress, and no action could be secured at that session. The answer of the State Department was to the effect that they were not aware of any modification of these stipulations; and there is little doubt that this company has wilfully disregarded the spirit, if not the letter, of its obligation to our Government—"not to combine with any other company for the purpose of regulating rates." Your committee recommend that the subject be pressed upon the attention of the next Congress, and that an effort be made to compel this company to comply in good faith with its stipulations, which would doubtless result in a return to the former rate of twenty-five cents per word, which rate was in force previous to the combination which took place on the 22nd of May last.

The report was accepted, and the following resolution was adopted on the motion of Mr. Thurber :—

Resolved, That the thanks of this board be and are hereby tendered to the Hon. S. S. Cox, member of Congress from this city, for his efficient aid in the matter of the French cable rates and also in securing safeguards for the public interest in the charters of two new ocean cable companies which were granted during the closing hours of the last Congress. In both of these, owing to Mr. Cox's exertions, provisions were inserted against pooling or combination, and in one of them a maximum rate of twenty cents per word was fixed on.

The companies referred to were formed by Philadelphia and Baltimore capitalists.—New York *Herald*, October 12th, 1882.

Transmission of Work to a great Distance on an ordinary Telegraph Wire.—By M. M. Deprez.—The Electrotechnical Committee of the Exhibition of Electricity at Munich having requested me to repeat upon a telegraph line the experiments on the transmission of power which I had previously made over great resistances, I forwarded to Munich and Miesbach the fine wire machines which I had made use of in my laboratory experiments.

The telegraph line placed at my disposal by the administration of the German telegraphic system had a length of 57 kilometres. It is of galvanised wire 4·5 millimetres in diameter, and since, as a matter of precaution, I did not think fit to make use of the earth, I requested permission to employ a return-wire identical with the former. The total length of the line traversed by the contact is, therefore, 114 kilometres, and its resistance, on measurement, = 950 ohms. The insulation is good, but differs in nothing from that universally employed on all telegraph lines. The two machines, situate the one at Miesbach and the other at Munich, are absolutely identical, and have each a resistance of 470 ohms.

The total resistance of the circuit is, therefore, close upon 1,900 ohms. In the first experiment which was made there was immediately obtained at Munich a work of 38 kilogrammetres per second (or about $\frac{1}{2}$ horse-power), at a speed of 1,500 revolutions per minute.

The generating machine, situate at Miesbach, turned at the rate of 2,200. The two machines being identical, the proportion of the work recovered at Munich to the work expended at Miesbach was, setting aside passive resistance of every kind, $= \frac{1500}{2200}$, or more than 60 per cent. The machines employed are of Gramme's "atelier" type, modified according to my calculations.

rain fell during almost the whole duration of the s.

iving-machine serves at present to feed a waterfall of one metre in width and three in height, by means of a centrifugal pump.

Sparks are scarcely visible on the collectors of the two machines. The heating of the machines is scarcely appreciable after two hours' work.—*Comptes Rendus.*

Earthquakes in Peru.—The Panama *Star and Herald* of the 28th September says :—Latest news from Lima reaches to the 17th. It was transmitted by cable to Payta, thence by steamer to Equador, whence it came on by cable. On Thursday, the 14th inst., a severe earthquake was experienced in Lima, which was followed by a lighter one on Friday, the 15th inst. So far no damage is reported. It now appears the Payta cable was broken by this shock. Under date of the 5th October, the same paper says :—The *Retriever* has succeeded in picking up and repairing the Payta-Santa Elena cable, so that electrical communication is now complete between all the stations of the Central and South American Cable Company. Mr. E. W. Parsoné was in charge of the work. The break, as suspected, had been caused by the earthquake felt in Peru on September 14th.

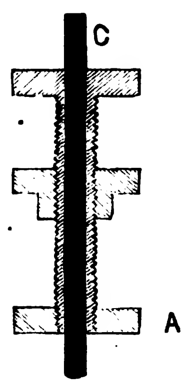
New Land-line.—We are informed that the Panama Railway Company has constructed a new land-line across the Isthmus, as the telegraphic communication has been frequently interrupted from various causes. Iron posts have been used for this purpose.

The Kerite Anti-Induction Telephone Cable.—We have received from Mr. A. G. Day, says the *Operator*, a sample of his latest form of aerial telephone cable. This new cable is designed to overcome certain objections pertaining hitherto to aerial cables of more than one conductor. It has been customary, in the construction of such cables, to cover each separate insulated conductor with tin-foil for the purpose of diminishing the interference caused by the induction of one current upon another. This has had the effect, however, of greatly increasing the static induction in each conductor, so that, on account of the retardation of the current, it has not been found practicable to use such cables for a greater distance than three or four miles. In the kerite cable each conductor has a covering of kerite, and outside of this a thin coating or wash of plumbago. The sample of the cable which we have contains 36 conductors. The central core consists of seven fine wires twisted together, insulated with kerite and covered with tin-foil. The remaining 35 conductors are placed in three layers of 6, 11, and 18 wires respectively, each wire being covered with kerite and washed with plumbago, as described. The layers are disposed helically, alternately to the right and the left. The entire cable is sheathed with tin-foil and enclosed in a strong fabric impervious to the weather. Mr. Day, the manufacturer, says these cables can be worked for a distance of ten miles either above or beneath the ground. The Metropolitan Telephone and Telegraph Company of this city has 12 miles of the kerite cables in use. They are also employed in Cincinnati, Chicago, St. Louis, Baltimore, Brooklyn, Detroit, Boston, and other cities. The Baltimore and Ohio Telegraph Company has kerite cables in use for telegraphic purposes between this city and Fourth Avenue and Flatbush Avenue, Brooklyn, a distance of about four miles.

The Society of Telegraph Engineers and of Electricians.—The first meeting of the autumn session of this society will take place on Thursday, November 9th, at 8 p.m., when a paper will be read on the Munich Electrical Exhibition, 1882, by W. H. Preece, F.R.S., past president.

Rogers' Improved Relay Contacts.—The oxidising and fusing of relay contacts is a constant source of trouble in some instruments. This, to a very great extent, arises from the contacts being made of an incorrect shape. The usual plan of having a small flat platinum plate soldered to the relay tongue, and a flattened point to the contact screw, although very generally adopted, is in reality a mos[illegible] arrangement, and it is the chief cause of sti[illegible]. The proper arrangement is to have the two surf[illegible]

exactly the same diameter. In the Postal Telegraph Department the whole of the relay contacts are formed of platinum wire, about 1-16th of an inch in diameter, this wire being used both for the relay tongue and the contact screw; care is taken that the contacts are as nearly opposite one another as possible, so that no overlapping occurs. In cases where this form of contact has been substituted for the old point and plate, a marked improvement has been effected in the working of the instruments. Mr. F. M. Rogers proposes to get rid of the sticking by employing a carbon contact on the contact screw; as carbon cannot be melted, it is evident that the fusing of the two surfaces cannot take place. A point which deserves mention with reference to Mr. Rogers' invention (which is patented), is the fact that relays so fitted,



will work with the contacts screwed very close together, they will work in fact when the two actually touch; this is due, of course, to the microphonic action which takes place. For fixing the carbon in the contact screw, Mr. Rogers adopts the arrangement shown by the figure; a length of the carbon, C, about 1-16th of an inch in diameter passes through a tube tapped on the outside along its length. At the end where the contact emerges the tube is turned slightly conical, the screw thread being tapped on the cone; this end of the tube is slit down for a short distance by two slits at right angles to each other; by screwing the nut, A, along the conical end of the tube, the carbon wire becomes firmly gripped. This device enables the contact to be made good, if by any chance it should become broken.

An Experiment with the Electric Light.—By Lud. Pilleux.—Every one knows the action of continuous currents and the similar action of permanent magnets upon an electric arc produced by continuous currents. We know also, especially since the experiments of M. Jamin on the electric light, the action of alternately reversed currents upon an arc produced by alternately reversed currents, an action similar to the former. But the case is different with the action of continuous currents and permanent magnets upon a galvanic arc produced by currents alternately reversed.

The author then describes an experiment in which he studied this action under favourable conditions as follows:—

"Having at my disposal a powerful vertical voltaic arc of 12 millimetres in length, maintained by an alternately reversed current, and one of the most powerful magnets which M. Méritens makes use of for the construction of his electro-magnetic machines, I slowly approached one of the poles of my magnet to the galvanic arc. As soon as I had got to the distance of about 10 centimetres, I saw the arc flatten itself out so as to take almost the appearance of bat's-wing gas-burners, the plane of the bat's wing being parallel to the pole of the magnet.

"At the same time the arc began to give out a loud noise, like that of hail when it falls upon window-panes.

"As I approached the arc grew narrower and the noise increased so as to be deafening. When the magnet was not more than a few millimetres distant from the arc the latter, which had become thinner than a leaf of paper, burst asunder with a crash, scattering fragments of glowing carbon.

"The magnet which I used being a horse-shoe, it was easy to change the pole presented to the arc by a small sidewards movement. The arc then executed a most singular pirouette, revolving on itself, so as to present to one pole a different surface from what it had presented to the other."—*L'Italienne.*

NEW COMPANY REGISTERED.

Scottish Gülcher Electric Light and Power Company (Limited).—Capital £150,000, in £5 shares. Objects: To purchase the exclusive licence for the use of the Gülcher System of Electric Lighting in Scotland, for £25,000 in cash, and £25,000 in fully paid shares. Signatories (with one share each): F. Grant, 93, Leconfield Road, Highbury New Park, N.; C. R. A. Darby, 418, Commercial Road; A. W. Barneveld, 87, Sharedeloes Road, S.E.; J. H. Slater, 58, Haverstock Hill; W. C. Cross, 4, Mona Road, Peckham; W. J. Vokes, 360, Kennington Road; J. Arnold, 15, St. Andrew Street, Wandsworth Road. The signatories are to appoint the first directors; remuneration £500 per annum. Registered 27th ult., by Quick and Bidder, 13, George Street, Mansion House.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

The following returns have been recently filed:—

Anglo-American Telegraph Company (Limited).—The annual return of this company, made up to 24th of February, was filed on 14th of March, and states the nominal capital of the company to be £7,000,000 stock, fully paid up.

British Electric Light Company (Limited).—The annual return of this company was made up and filed on 27th July. The nominal capital is £100,000, in £10 shares; 7,221 shares are taken up and the full amount has been called upon the same. The calls paid amount to £71,600 and unpaid to £510.

Direct Spanish Telegraph Company (Limited).—The return of this company, made up to the 14th of April, was filed on 30th April. The nominal capital is £130,000, in 13,000 ordinary shares of £10 each; and £60,000 in 6,000 10 per cent. preference shares of £10 each. 12,931 ordinary, and 5,843 preference have been allotted. Upon the former £9 has been called up, and the full amount upon the latter. The calls paid upon the ordinary shares amount to £116,379, and upon the preference to £58,430.

Single Wire Multiple Telephone Signal Company (Limited).—The return of this company, made up to July 6th, was filed on July 21st. The nominal capital is £5,000, in £10 shares. 102 shares have been taken up and are fully paid.

Manchester and District Edison Electric Light Company (Limited).—The return of this company, made up to the 6th ult., was filed on the 23rd ult. The nominal capital is £600,000, in £10 shares. 20,000 shares have been allotted, and £2 per share called up, the calls paid amounting to £20,000. (?)

Electric Light Syndicate (Limited).—The return of this company, made up to September 23rd, was filed on the 24th ult. The nominal capital is £3,000, in £50 shares. 51 shares have been allotted and the full amount called thereupon, the calls paid amounting to £2,500 and unpaid on forfeited share £50.

Albion Electric Lamp Company (Limited).—The return of this company, made up to September 28th, was filed on the 5th ult. The nominal capital is £10,000, in £10 shares. 886 shares have been taken up. The full amount has been called on each paid-up share and 2s. 6d. upon each share of the second issue. The total calls paid amount to £2,036. 7s. 6d.

Cuba Submarine Telegraph Company (Limited).—The return of this company was filed on February 8th. The nominal capital is £220,000, in 22,000 shares of £10, viz., 16,000 ordinary and 6,000 preference. The full amount has been called up, the calls paid amounting to £220,000.

Brazilian Submarine Telegraph Company (Limited).—The annual return of this company, made up to May 26th, was filed on June 5th. The nominal capital is £1,300,000, in £10 shares. The whole of the shares are taken up and fully paid.

NEW PATENTS—1882.

5097. "Secondary batteries." R. HAMMOND and L. GOLDENBERG. Dated October 26.

5098. "Electric lamps." A. MACKEAN. (Communicated by A. Kryszat.) Dated October 26.

5104. "Improved compounds or preparation of materials for use in place of leather, and for electrical insulation, enabling improvements in the manufacture of electric conductors." M. BAUER, L. BROUARD and J. ANCEL. Dated October 26.

5105. "Improvements in electric lighting, and in apparatus connected therewith, partly applicable to other purposes." P. CARDEW. Dated October 26.

5108. "Galvanic batteries." P. R. DE F. D'HUMY. Dated October 27.

5122. "Electric current generators and motors." S. P. THOMPSON. Dated October 27.

5126. "Telephonic apparatus and electric call bells." H. G. ELLERY and J. T. GENT. Dated October 27.

5129. "New or improved compositions for insulating conductors of electricity, and for other like purposes." E. W. TOBB. Dated October 27.

5142. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated by B. Egger.) Dated October 28.

5148. "Improvements in the organs of dynamo, magneto, or electromotive machines, and in other electrical apparatus, in the construction of which iron, cast-iron, steel, and other metals are used." B. J. B. MILLS. (Communicated by F. Chutaux.) Dated October 30.

5149. "A new or improved process for increasing the conductibility of, and for insulating round or flat cables or wires employed in the construction of magneto and dynamo machines, and other electrical apparatus." B. J. B. MILLS. (Communicated by F. Chutaux.) Dated October 30.

5158. "Apparatus for producing and regulating electricity." J. D. F. ANDREWS. Dated October 30.

5164. "Telephonic apparatus." J. G. LORRAIN. Dated October 30.

5166. "Circuits for telephonic communication." H. ALABASTER and T. E. GATEHOUSE. Dated October 30.

5167. "Telephonic receiver." H. ALABASTER and T. E. GATEHOUSE. Dated October 30.

5170. "Electric batteries." F. WIRTH. (Communicated by G. Leuchs.) Dated October 30.

5174. "Arc electric lamps." F. S. WILLARD. Dated October 31.

5181. "Apparatus and appliances for accommodating electrical conductors in the streets of towns." H. F. JOEL. Dated October 31.

5182. "Telegraph printing and time regulating apparatus." J. IMRAY. (Communicated by A. A. Knudson.) Dated October 31.

5183. "Improvements in secondary voltaic batteries, and in apparatus for regulating their charge and discharge." R. H. WOODLEY and H. F. JOEL. Dated October 31.

5200. "An improved method of controlling valves or cocks by electricity or by heat, and in the means employed therefor." J. FORMBY. Dated October 31.

5205. The utilisation of various gums as substitutes for gutta-percha and india-rubber for insulating and other purposes." J. E. T. WOODS. Dated November 1.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1137. "Telegraphic apparatus, &c." W. H. DAVIES and F. H. W. HIGGINS. Dated March 8. 1s. Relates to apparatus similar to that described in the number of the ELECTRICAL REVIEW for Sept. 15th, 1881.

1163. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by E. Weston, of America.) Dated March 10. 6d. This invention relates to electric arc lamps in which are employed, in conjunction with a single set of feed regulating magnets, two sets or pairs of carbon pencils and independent feeding devices connected therewith, which devices, by the consumption of the carbons, are brought successfully under the controlling influence of the aforesaid magnets. In lamps constructed according to this invention the carbons or electrodes are fed and adjusted by means of clutch mechanism consisting essentially of a plate or bar connected at one end to a movable armature, or its equivalent, and resting at the other end upon a lamp-frame. The said plate or bar is perforated and surrounds the carbon-carrier. When the armature is raised and the plate connected therewith is tilted a short distance it grips the carrier so that the position of the latter depends upon the elevation of the armature.

1171. "Mechanism for regulating the burning of carbon or other electrodes in electric lighting apparatus." A. GRAHAM. Dated March 10. 8d. Relates to mechanism to be applied to electric lamps or lighting apparatus for regulating the burning of the carbon or other electrodes thereof by currents generated in a dynamo-electric machine [illegible] battery.

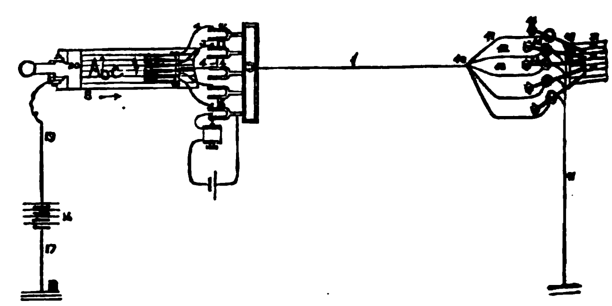
1173. "Electric accumulators." J. H. JOHNSON. (A communication from abroad by A. de Méritens, of Paris.) Dated March 10. 2d. Consists in certain improvements in the construction and arrangement of the secondary batteries or electrical accumulators, whereby they are rendered more durable and efficient. (*Provisional only.*)

1174. "Generation, distribution, storing, &c., of electricity, and apparatus therefor." J. S. WILLIAMS. Dated March 10. 1s. 8d. Relates to apparatus, methods and means for generating, distributing, storing, utilising, measuring, and regulating electricity, and consists partly in utilising the water reservoirs and the pipes or mains for conducting and supplying the water to cities, towns, and other places, for the purpose of driving water or turbine wheels with which are combined dynamo or magneto-electric generators for producing electric currents.

1191. "Regulating the generative capacity of dynamo or magneto-electric machines." T. J. HANDFORD. (A communication from abroad by Thomas Alva Edison.) Dated March 11. 6d. Has for its object the provision of simple and efficient means and methods for automatically regulating the generative capacity of dynamo or magneto-electric machines, which means will act automatically upon the addition and removal of lamps or other translating devices to produce corresponding changes in the energy of the exciting or field of force magnet. According to one modification, the lamps or other translating devices are divided into groups, the lamps of each group being those that are in multiple arc or derived circuits from the same pair of conductors branching from the main conductors. There is provided in connection with each group means for regulating the current energising the field magnet of the machine operated by the current generated and acting automatically upon the addition or removal of translating devices in the group. This means may be an electro-magnet in one of the branch conductors having an armature lever retracted by a spring and making and breaking a circuit, which may be a shunt around a definite resistance in the field circuit or an additional field circuit, the result in either case being an increase in energy of the field magnet by the closure of the circuit controlled by each of these electro-magnets. Each of these magnets is so constructed and arranged with relation to its armature lever that it will not draw the lever to its front contact until a number of the lamps of the group have been turned on, so that the additional energy given to the field magnet by the operation of the devices connected with each group will be sufficient for the supply of all the lamps of the group.

1195. "Electric circuits, &c." W. P. THOMPSON. (A communication from abroad by H. Kerner, of New York, America.) Dated March 11. 6d. Relates to the burglar alarm apparatus described on page 311, in the number of the Journal for October 21st.

1222. "Transmitting and receiving telegraphic messages, &c." H. H. LAKE. (A communication from abroad by A. L. Parcelle, of America.) Dated March 14. 8d. The first part of this invention relates to that class of automatic telegraphs known as "*fac-simile*," "autographic," and "pantographic," in which a practical *fac-simile* is produced at a receiving station of the line of a message written at the transmitting station. The part of the said invention has for its object to provide an improved apparatus of the class adapted to reproduce in *fac-simile* a message written on ordinary paper with a metallic ink, and to this end it consists in the employment at the transmitting station of a series of reeds, each tuned to vibrate at a different rate from the others; a corresponding series of reeds at the receiving station, each series having a corresponding series of electro-magnets, a metallic table connected with the receiving reeds in a local circuit,



and adapted to support a strip of chemical paper for the action of the receiving reeds, and means for closing a circuit through either of the transmitting reeds the line and the corresponding receiving reed by the action of lines or characters written in metallic ink on ordinary paper at the transmitting station, so as to reproduce in *fac-simile* upon the chemical paper at the receiving station, the characters written in metallic ink at the transmitting station. Referring to fig. 1, the main line is subdivided at the transmitting station, into a series of branches, 2, 3, 4, each of which branches includes in its circuit a pressure spring, 5, 6, 7. These springs press upon the surface of the transmitting sheet, 8, on which the message represented in the figure by letters A, *b*, *c*, has been previously written with conducting ink. The paper sheet, 8, is provided with parallel lines ruled with conducting ink in the direction of the motion of the sheet, as represented by the arrow. The springs press upon the intervening spaces [illegible] these ruled lines. Each branch, 2, 3, 4, also includes [illegible] for rendering the current pulsatory. It is preferred [illegible] for this purpose the tuning forks seen at 12, 13, 14, fig. [illegible] are kept in continuous vibration by the action of local [illegible] which an example is shown, together with a convenient [illegible]

cuit-wires as applied to the tuning fork, 15. One pole of the main battery, 16, is connected by means of the line, 17, with the earth at 18; the other pole is connected by means of the line, 19, pressure clip, 20 (which serves to secure the paper to its underlying holder), ruled lines, 9, 10, 11, to the characters written upon the transmitting sheet. It will, therefore, be understood that, whenever one of the springs, 5, 6, 7, comes in contact with any line of the written message, the battery, 16, will be put in connection with the main line, the current traversing the line, 19, pressure clip, 20, ruled lines, 9, 10, 11, the character to be transmitted the spring in contact therewith, the particular rheotome situated in the said branch circuit, and the main line. If simultaneously two or more of the branch circuits are thus closed, the resulting pulsations upon the main line will be made up of the contributory pulsations of the fractional currents. Further, it will be understood that the duration of the contact of the springs, 5, 6, 7, with the lines of conducting ink, will depend upon the longitudinal width of the said lines, while the instant of contact will depend upon their situation upon the transmitting sheet.

1225. "Apparatus for gauging carbon filaments, wire, &c." M. Evans. Dated March 14. 6d. In the manufacture of incandescent electric lamps it is important that the carbon filaments in all the lamps which are to be actuated by electricity from the same source of supply should be of one uniform thickness or gauge; the process of gauging or testing the thickness as hitherto followed is slow and tedious, and can only be efficiently performed by practised persons. The primary object of the invention is to construct an apparatus by which the gauging of the filaments can be rapidly performed by persons of little or no experience. The invention essentially consists in the employment of a movable jaw, between which and a fixed jaw or stop the filament to be gauged is held, the greater or less proximity of the movable jaw to the fixed jaw, as determined by the thickness of the filament, regulating the angle or position of a mirror which reflects a pencil or beam of light upon a screen marked off as a scale. The particular point of the screen to which the light is reflected indicates the gauge or thickness of the filament.

1254. "Telegraphic relay." J. Ebel. Dated March 15. 4d. Relates to an improved telegraph relay, and has for its object to so construct such a relay, that it will be very simple and extremely sensitive, and will cost but little to manufacture. In carrying the said invention into practice the inventor employs an electro-magnet, with one bobbin of insulated wire, within which is placed a compound soft iron core. The centre part of this soft iron core moves freely on pivots and is prolonged on both ends in the form of tongues or armatures. Adjacent to each of the said upper and lower armatures are arranged steel horse-shoe magnets, which are so placed with regard to the said armatures, that the same can move to and fro, or vibrate between their poles. It follows from the above described construction of the relay that if a weak or feeble current is produced in the wire bobbin, it will magnetise and induce magnetism in the iron centre core and armatures, and will, consequently, according to their polarity, be attracted or repulsed by the poles of the magnets.

1271. "Telephones." A. W. Rose. Dated March 16. 4d. Has for its object to so construct and combine the receiving, transmitting, and magnetic signalling parts of telephonic apparatus together, that the instrument so combined is more convenient in use than has hitherto been the case, and so also that the cost and inconvenience of combining these parts after the instruments are sent out of the factory are avoided.

1274. "Incandescent electric lamps." F. Wright and M. W. W. Mackie. Dated March 16. 2d. Relates to improvements in electric lamps operated by incandescence, and consists, firstly, in an improved form of vacuum bulb, with tubular stem for carrying the conducting wires and pump tube. Secondly, in the production of vegetable fibres free from mineral and inorganic matter as the bases of the filaments or bridges. (*Provisional only.*)

1288. "Incandescent lamps, &c." J. B. Rogers. Dated March 16. 6d. Relates to certain improvements in incandescent lamps, also in fittings and switch attachments for electric light apparatus. According to the first part of the invention, the inventor fits two terminal ends of platinum or other suitable metal within the globe or other glass; the ends have the filament attached by inside conical tubes of platinum or other metal into which the two ends fit and keep themselves in contact, and prevent any slip of the filament from the ends of the poles. By this means perfect contact is insured. The ends may be hard soldered if necessary. According to the second part of the invention, the inventor screw-threads the socket of an incandescent lamp and terminates the two wires or one wire only at the base. He also screw-threads the socket attachment and terminates the lead wire or wires just outside its end, so that when the two screw-threaded pieces are screwed into close contact the wires are put into electrical connection. On the socket being turned in the reverse direction the contact of the wires becomes broken.

1302. "Electrolier." The Honorable Reginald Brougham. Dated March 17. 6d. Has for its object an improved electrolier. This electrolier is intended for the exhibition of several electric lamps of the incandescent type. It consists of a tubular stem or upright descending from the ceiling of the room to be lighted, or fixed vertically in a suitable standard, or otherwise suitably supported. There is a collar upon the stem near its end, and beyond this again a flanged nut is screwed upon the stem. Between the collar and the nut two metal plates of ornamental form are clamped and held. These plates are kept apart by a thick disc of vulcanite (or other non-conductor) and thinner discs of like material serve to insulate the plates from the collar and the nut upon the stem. The parts of the plates overhanging the separating disc are formed with radial grooves on their inner surfaces. The neck of the lamp or glass bulb in which the carbon filament is enclosed is set into a socket of vulcanite or other material, and two brass springs or plates are fixed to the exterior of this socket diametrically opposite to each other; to these springs or plates the wires which enter the glass enclosure are attached. Each lamp when thus set into a socket is inserted between the two plates carried by the stem or upright of the electrolier, and the springs or plates entering the radial grooves serve to hold the lamps in place. The same springs provide the electrical connections for the filaments, the plates being in connection with the electric source. Conducting wires pass down the interior of the stem, and are brought out through a hole in the separating disc of vulcanite or other insulating material and connected to the plates.

1303. "Telegraphic and telephonic systems." P. M. Justice. (A communication from abroad by Fr. Van Rysselberghe, of Belgium.) Dated March 17. 6d. Where a network of wires exist which are employed for ordinary telegraphy, it has hitherto been extremely difficult to practically employ one or more wires for telephonic communication owing to the loss of current by induction, and also to the currents induced from other lines. The object of the present invention is to remedy this defect, and to enable one or more wires of a system to be employed for telegraphy or for telephonic communication. This result may be attained by modifying the present known systems and apparatus, and by applying known instruments which have not hitherto been employed to secure the object indicated. The modifications consist principally in using batteries of low resistance, microphones coupled up in quantity, induction coils of high resistance, and condensers.

1324. "Electric lamps." J. D. F. Andrews. Dated March 18. 6d. Relates to a clutch lamp and has for its object great delicacy and certainty of action. In the present invention the inventor effects the object by detaching the clutch from the armature that works it so that this armature is capable of giving a certain amount of regulation without working the clutch, and works it only when feed of the carbon is required.

1327. "Transmission of electric currents of high tension." L. J. Crossley, J. F. Harrison, and W. Emmott. Dated March 18. 6d. Relates to the arrangement of certain electric appliances by means of which telephone and other lines of suitable resistance may be used for the conveyance of powerful currents of electricity for electric lighting, electro-plating, the transmission of power and for other purposes where electricity of high tension is employed without danger to the usual telephonic, telegraphic and other instruments. In carrying out the invention in connection with the conveyance of high tension electricity over telephone lines the inventors place in the exchange a number of dynamo-electric machines or other suitable generators of electricity connected with a switching arrangement by means of which the currents generated may be distributed to the various subscribers. Connected with the switch is an annunciator adapted to suit high tension currents by means of which any accident to the line is immediately made known at the exchange, the said annunciator also allows the subscribers to call the attention of the operator in case they wish to speak during the time the high tension currents are passing over the line. Connected with each subscriber's instrument is a relay or other appliance constructed and arranged so that the high tension currents for electric lighting or other purposes shall not injuriously affect the said instruments; a secondary battery may be used in connection with the said instruments, by means of which a supply of electricity can be stored to allow the subscribers to use the telephone without interfering with the light or otherwise. Arrangements may be provided whereby the secondary batttery can be charged from the exchange without troubling the subscriber.

1356. "Telephonic receiving apparatus." R. Theiler and M. Theiler. Dated March 21. 2d. Relates to an improved and simplified construction of telephone receivers in which the tympanum or diaphragm, also the permanent magnet and the ear-piece or funnel common to other telephones, are entirely dispensed with. In the telephone receivers of Reis, Gray, Bell, and other inventors, the tympanum, diaphragm, or sounding board constituted a necessary part of the apparatus, because the electro-magnet and armature constituting the remaining parts of the apparatus were not constructed in such a manner that the vibrations of articulate speech could be heard without the aid of a tympanum or other resonant surface. The new telephone receiver consists only of an electro-magnet, to one pole of which is usually fixed a stem or knob which can be conveniently inserted in the ear of the listener. The vibrations of the electro-magnet produced by the vibratory current passing through the latter are thus directly communicated to the walls of the ear, and the effect of those vibrations upon the ear is not diminished by an intervening air space, as is unavoidably the case in telephones with tympanums or diaphragms. (*Provisional only.*)

CITY NOTES, REPORTS, MEETINGS, &c.

THE EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY (LIMITED).

Under the presidency of Mr. John Pender, M.P., chairman of the company, the eighteenth ordinary general meeting of the shareholders of the above-named company was held at the City Terminus Hotel on Wednesday afternoon.

The secretary, Mr. F. E. Hesse, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have had the report in your hands for some days. I presume you will take it as read (agreed). The revenue you will observe is as follows: gross receipts for the

half year ending June 30th amount to £207,119, against for the corresponding period of 1881 £191,580, showing an increase of £15,539. Of this £3,728 is due to profit on exchange and additional interest on loans during that half year, and the balance £11,811 represents growth of affairs. The expenses for the half year have been £50,355, against for the corresponding period of 1881 £54,098, a decrease of £3,743. This is caused by the expense of the repairing of ships being reduced in consequence of the chartering of the steamer *Agnes* by the New Zealand Government for the repairing of their Cook's Straits' cable. The net revenue has been £113,393, against, for the corresponding period of 1881, £94,755, showing an increase of £18,638. The dividend due on the half-year, together with the bonus of one shilling per share, making 3 per cent. for the half-year, has been distributed. The board has also charged £30,000 against the half-year's revenue in payment of the balance, leaving £23,468 to be carried forward. This cable has worked well since put down in November, 1881. It would be interesting to mention that the brass riband cable laid four years ago in the original Java-Darwin cable has so far successfully resisted the action of that troublesome insect, the teredo, which was found to be so destructive on the old Batavian section. The remaining sections have been interrupted but a few hours whilst repairing the numerous small faults which have developed from time to time. Having stated thus much concerning our figures, I will now give you some facts connected with the working of our system during this last half-year. And before I ask you to approve the report and accounts, I desire to make a few remarks. Generally speaking, our system has been working well during the last six months. You are all aware that a considerable interruption, extending over a long period, occurred from the state of affairs in Egypt. The Eastern Company's service was so far interrupted across the Isthmus of Suez. That is now restored in such a way as, I hope, will prevent in the future any recurrence of a similar interruption. But fortunately for this company, as well as for the Eastern Company, the arrangement we had made with the Indo-European cable enabled us to carry on our traffic if not as efficiently, yet without any loss to the Eastern Company; and consequently without any loss, as you may see from the accounts laid before you, to the Eastern Extension Company. We have given very special attention to making our system as efficient as it is possible to make telegraphic communication. We have battled with the difficulty of the little insect teredo, and we have become the master. I am glad to say that we have positive evidence that we have been able to make such a cable that protects us against the ravages of this insect. We have still 230 miles in our system which is not armour-plated against this insect. It is our intention to replace that cable by a cable which will be perfectly proof against it. We shall take up the old one, which will be utilised in an efficient manner, and shall at the same time put our system into an efficient state. With reference to the Singapore-Batavian cable, which I previously stated would cost £94,000, we have now wiped out that sum, having placed £30,000 to that account in the balance sheet, which was required for those alterations in our system; therefore our capital has not increased, but our system has been materially strengthened for dividend paying. We wish to be in such a position, having such a system of telegraphy that will be efficient, and not only be appreciated by our shareholders and by those who use it, but that its security will be so much greater in the future than in the past, which will enable us to have more confidence in our dividend than hitherto. I think we have also in mind some important additions which I do not desire should add to our capital, so as to secure an alternative line, and embrace parts of the world not hitherto within our scope. All that we have in the future, and I hope, looking at the satisfactory accounts before you to-day, and looking to the future, we do not intend to increase our capital, but to increase the system which is under our control. I now propose the adoption of the reports and accounts now presented.

Viscount Monck seconded the motion.

Mr. Newton remarked that their company held one of the strongest positions of any company in existence, and he was sorry they did not pay an equal dividend with other companies. He endorsed the policy of the board generally, except that with reference to the reserve fund. They would hardly know how their reserve money stood by the way it was expressed in the balance-sheet. He was of opinion that money should go to the capital account, and not so directly to the reserve fund. He thought the present generation of shareholders should have the benefit of their earnings now, and not so much money be reserved. As it required under £20,000 to give the shareholders another one per cent., he thought they should have it in so prosperous a company as that was. No other company in existence carried so large a sum to the reserve fund as they did, at least no company with duplicated cables such as they had, and the generations to come would get the benefits of dividends instead of the present one, if they continued to work as successfully in the future as in the past. The £30,000 which they had transferred to reserve should first have been put to capital account. He thought there should have been clear figures on that point in the balance-sheet. He thought then the first security holders would have then had the satisfaction of seeing what a valuable property they had. He did not know whether it was that the board did not wish to surpass the Eastern company by giving 7 per cent., whereas they would probably remain at 5 or 6 per cent.? He hoped the time was not far distant when they would see themselves ahead of Eastern, for it was not possible, he thought, for a cable to be laid in competition with their field of work. They had no prospect of competition, and he thought, therefore, they of the present generation who had such a property should certainly have a little more than 6 per cent., and go on for 7 or 8. He also thought they should be able to get their debentures at 4 or 4½ per cent.

Mr. Abbott could hardly approve of the idea of making one telegraph company pay a larger share of dividend than another. He thought the fact that their stock stood so well in the market demonstrates the prudence of the management of the board, which would, he thought, be endorsed by the shareholders. Addressing the chairman more personally, Mr. Abbott said that Mr. Pender, so the newspaper had said, had been, to use a sporting phrase, "got at" by the Americans. He should be very sorry if Mr. Pender had lent his name to such a combination as the Western Union Telegraph Company, and he thought he would then be taking the very worst course he could. He thought their chairman should be so kind as to state to the shareholders why he did not join the Western Union Telegraph Company by joining the board.

The chairman in reply to the questions asked, said he was not at all surprised at Mr. Newton's criticism. He was quite sure Mr. Newton would agree with him in this, because he touched a very important point in their policy, and that was to get the debentures out at four per cent. if they possibly could. Mr. Newton would agree with him that they must get such a reserve as would enable them to make those bonds beyond all question secure (hear, hear). Whilst he should be glad to hear from Mr. Newton similar criticisms, he should be prepared to give his reasons. The board were increasing the property of the shareholders very materially. He would say, "Do not attempt to eat your cake and have it." That increase would enable the board to carry out the policy of this in such a manner as would enable them to preserve a sound footing. If people saw the reserve fund decrease, they did not like it; and it was better to please the people and keep the money in it. It amounted to the same. It was only a question of accounting. It was put to the reserve without passing it through the capital. He could assure Mr. Abbott that the interests and honour of the gentlemen associated with him in submarine telegraphy were as dear to him as their own. (Hear, hear.) The course he should pursue would be for the benefit of their cables and those interested in them. He was not "got at" by Mr. Field, nor by any other gentleman in America. He received generous and munificent treatment in that country.

The motion was then put and carried.

Mr. Abbott proposed a vote of thanks to the chairman, which was seconded by Mr. Newton, and the proceedings terminated.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

The 18th ordinary general meeting of the shareholders of the above-named company was held at Cannon Street Hotel, on Friday, 27th ult., Lord Monck, Chairman of the Company, presiding.

Mr. Richard Collett, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, I presume as usual you will take the report as read? Well, in moving its adoption, I have to make a few observations to you. The first in point of time and in point of importance is a consideration of what is the condition of your working plant. I am happy to tell you that it is in a perfectly sound condition; and within the last few hours we have received information, that the fault which you will perceive by the report existed in the Lisbon section has been removed, and the work of restoring communication by the cable has been practically accomplished. Gentlemen, I have a few words to say presently on that subject; I merely allude to it incidentally now in reference to your plant. I think if you will take the trouble of looking at the report sheets from the beginning of this company, you will find that there has been a steady, gradual, and progressive increase in receipts. I am happy to inform you that I can carry that information further than the tables published, which only go so far as June 30th last; and I can tell you that that increase of receipts has been going on since July in an accelerated rate. Well, gentlemen, the next subject which naturally suggests itself is the expense of working your plant, and of so obtaining these receipts. You have all, I presume, the report in your hands, and have had the opportunity of comparing it with other reports of previous years, and you find that the expenditure at the end of June last was £23,155, which, compared with the previous half-year, shows an increase of £10,686, which seems a large sum. You will find that £10,406 of that sum is due to the repairs of the Pernambuco shore end, which gave out last year; and we have effected its repair and renewal out of receipts, so that really the increase is only £282, which mainly consists of those items which naturally increase with the increasing traffic and increasing age of the company; I mean such items as salaries, which is responsible for £157 of the increase; rent, repairs, and so on, which, of course, increase as the number of *employés* increases, that number being necessary for the transaction of the larger business which you are doing. Well, gentlemen, so much for your expenditure and receipts. You are aware—happily and satisfactorily aware—that we have paid you within this year practically 7 per cent. on your capital, and we have done that now for the second year, having in the two preceding years paid you but 6 per cent. If this were an ordinary occasion, I should now sit down, having stated what I consider a flourishing condition of your affairs, and simply move the adoption of the resolution. But I think the fact that we have commenced duplicating the cable [illegible] an epoch in the history of your enterprise, and [illegible] to fig. you a very brief review of what has been done from [illegible] series and of calling your attention to the prospects of the com[illegible] a future. This company was started in 1873. You will re[illegible] of the there was a delay in the completion of the Lisbon-Mader[illegible] figure the cable, which prevented the company commencing wo[illegible] ink July, 1874. From the time that you commenced operat[illegible] conduct mean from the time that you commenced working, but [illegible] the way of fitting yourselves for it, you have received [illegible] your capital. You have received 7 per cent. for two ye[illegible] cent. for two years more. So that would give you 5 per[illegible] the year its construction was taking place, and leave a [illegible] to your credit. I have often heard in this room, and a[illegible] ings of this character, that 5 per cent. was not too larg[illegible]

on money sunk under the sea, and in such a risky condition as is capital invested in submarine cables is generally supposed to occupy. Well, gentlemen, I have never disputed that fact, but the policy of your board has been always so to manage your affairs as to get rid of the element of uncertainty, which is the element which renders 5 per cent. a bad return for money invested in this way. I have been told we were paying too small a dividend and putting aside too large a sum for renewals. We have rendered your investment secure, and so endeavoured to make it apparent that 5 per cent. is not a bad dividend on money invested in submarine cables. I have previously alluded to that line of policy on the part of the board, and we are now reaping the benefit of that policy, because we have now renewed the cable between Lisbon and Maderia without calling upon you for a single shilling. I have often said here, and I believe the shareholders generally agree with me, that as we had power enough in a single cable to carry our work, we should postpone the laying of a second cable as long as we could, because directly it is laid it begins to deteriorate. Those laid down recently are not of the same character as those laid at an earlier period. In the Anglo-American Company, of which I am chairman, we have this year picked up a cable that has been thirteen years in the water, in over 2,000 fathoms of water, repaired it, and it is now practically doing better work since it was first laid down. That is a piece of consolatory evidence for all who have money in submarine cables which were laid down at a much more recent date. With reference to this new cable laid down, our electrician reported, in the mouth of May, that a serious fault had developed itself in the Lisbon-Madeira section, and that if we attempted to repair that fault, having only one line, we should have to suspend our traffic between these two places for a certain period. In order to localise the fault—to ascertain where it actually is—you must apply such an amount of electric force to the cable as to run the risk of breaking it down altogether. Having the money in hand, your board came to the conclusion that under all the circumstances, the best thing they could do was to lay down first a new cable between Lisbon and Madeira, and then proceed to repair the old one. We did this unwillingly, because we were not willing to do that so long as we could put it off. I think you will say we were wise in taking that course, which did not require us to suspend our operations, and we could continue them without any break whatever. We have now a duplicate line between Lisbon and Madeira; and we still adhere to the policy of postponing duplicating as long as we can. We shall not do so until the necessity arises, although we may have the money in hand. The reserve fund, after paying for the new Madeira cable, now amounts to £354,000; and the effect of that upon the value of your property is apparent if you look into the newspapers. Your £10 shares for a long time hung between £7 and £8; they are now between £12 and £13; your capital, after having received 5 per cent. on it, is now 25 per cent. more valuable than at the beginning of the transaction. I think, without egotism, that you may congratulate yourselves upon the management of the concern, and upon such a result. We shall pursue the same policy as we have hitherto adopted, while laying by a sufficient sum to meet any demand for the purposes of renewal, to give every shilling beyond that to the shareholders, in the way of dividend. I think we can see, at some little distance, if we are blessed with the same immunity from disaster and accident in the future as we have enjoyed in the past—I think I can see the time when we may suspend any further additions to the renewal fund, and divide the whole of the receipts of the company in dividends amongst the shareholders. No one will rejoice more than I will when that time arrives, when the operation can be performed with due regard to the permanence and well doing of your plant and work. I will now move that the report and accounts of the directors of the 30th of June, now submitted, be approved and adopted, and that a final dividend of 3s. per share, making, with the interim dividend, a total dividend of 6 per cent. for the year ended 30th June; and also the payment of a bonus of 2s. per share in respect of profits on the year ending the 30th June, both to be free of income-tax, be declared.

Sir James Anderson seconded the motion.

Mr. Newton asked if the New York and West Coast Cable was likely to interfere with this company in any degree; and whether they would be able to meet that competition if any should arise, and whether the Chairman would tell the shareholders anything as to the business capabilities of the Hon. William St. John Brodrick, M.P., the new director?

Mr. Griffiths said he was sure the report which had been presented, and the remarks made upon it by the Chairman, must commend themselves to all persons of judicious mind. There was, however, one point to which he could not help turning his attention. They had been told there was a fault existing for many years, and repaired without duplication. Might not the Lisbon and Maderia cable have been repaired without duplication? The cables have worked well with their fault. No one can contemplate without a feeling of dismay, what would be the consequence to their business if the whole of their business were suspended. Of course if the opinion of their electrician was that it could not be repaired—

The Chairman said they must all be aware that a fault in a cable [illegible] a question of degree, and they were entirely in the hands of their [illegible]ricians. Last May they were informed of the fault alluded to, [illegible] was of a grave nature—that the cable might give out at any [illegible]t. He would ask any man in his senses whether that was not [illegible]est thing to do—to lay down a new cable. The only answer [illegible]d give was, the probability of the cable giving out, and if [illegible] had to suspend operations for four or five months during [illegible]r, when they could not easily repair it, the thing spoke for [illegible]ith regard to Mr. Newton's questions, the articles of asso[illegible]t the selection of a director, in case of a vacancy, to the [illegible]e believed the new director would be as useful a member [illegible]d as any other gentleman upon it.

[illegible]uston said as they had £50,000 to the reserve fund and had [illegible]e sum of accumulated dividends, he thought in those circumstances he should receive another per cent. dividend, and still put a very good proportion to the reserve fund in comparison with their capital, when he looked to other companies in which he was a shareholder. He was not going to make an amendment, but he would leave it to the good sense of the board to take that matter into consideration in the future. The Eastern, with a capital of five millions, put £75,000 to the reserve fund last year; the Anglo, with a capital of seven millions, put £150,000. And supposing this company had put £37,000 of the revenue to the reserve fund, they would have been able to make it £50,000 with the accumulated dividends. He asked the board to try and give them a little more dividend in the future. Hopes had been held out for some years——

The Chairman: And realised (laughter).

Mr. Houston said with respect to the cost of the section, £100,000, which was laid by the Telegraph Construction and Maintenance Company, he heard that other companies did not get a chance of doing any work for this company. There were the India-Rubber Company and Siemens' Company. He thought the chairman said they would never duplicate the cable without bringing the matter before the shareholders.

The Chairman: No, no.

Mr. Newton said he had seen a circular to the effect that this company was making reductions. He thought if that were not so they should not be made the dupes of stockbrokers. It seemed to him that there was no fear of this company being interfered with by competition.

The Chairman said: Questions of competition had not yet arisen. The shareholders might be sure that the directors had not forgotten the chance of competition, or of the measures which it might be necessary to take in order to meet it. The board had considered the subject, and were considering it, and would do what was best in their judgment to meet the competition. With reference to Mr. Houston, who said, that judging by his experience of other companies with which he was connected, he had expected larger dividends than he was paid there, he (the chairman) was connected with some other companies, and he felt rather inclined to ask Mr. Houston, after the meeting was over, for a private interview; for he protested he did not know where such companies existed as he spoke of. It would be very satisfactory to himself and his friends, as investors, if they could find out those companies which were in such a flourishing condition (laughter). It would be very desirable to give 8 or 9 or 10 per cent., if they could do so with safety to the company. Mr. Houston would remember that that subject was introduced before, and he told him it would be studied in the future. They were endeavouring, consistently with paying what he ventured to call a large dividend, to build up a fund which would render their property safe, and when the time arrived in which, in the judgment of the board, it was not necessary to further add to it, they would divide every shilling of it. They must allow to them as directors, if they were to be directors, some judgment in the matter. With reference to the cable being repaired by the Telegraph Construction Company instead of by any other, he might say that they did not take their cable into the market and offer it for public tender, but they took a means of ascertaining what it ought to be done for, without going into the market for a public tender. They had had a great many dealings with the Telegraph Construction, and they never had one with them but what was satisfactory. He thought that when they had a man who served them well, and did work well and cheaply, it was wrong to leave him.

Mr. Newman said that having put down that cable he supposed it was a spare cable. He would like to know whether the expense of a cable now was greater than when theirs was first laid down? In the course of a somewhat rambling speech, during which there were cries of "Time," Mr. Newman said that the chairman had said he saw the time when he hoped all their receipts would be divided. Mr. Newman hoped that would not be another ten years (laughter). Nine years of their twenty years had expired. He thought they ought to have at the balance of their reserve fund such a sum as would give a dividend of 2½ per cent. to the shareholders, leaving 2½ per cent. to be received from the receipts from the cables. If they did not take some care at the end of their time their shares would not be at £13 as they were now. He thought they should be able to lay down a second cable if necessary.

Mr. Griffith remarked that some of the companies leased their cables, one condition being that the company which erected them should keep them in order. If that were done by this company he thought they would be able to have a smaller reserve fund. If such a plan could be adopted with the Telegraph Construction Company it would remove all those questions about the renewal fund.

The Chairman thought that burning question was nearly extinguished. He thought a good reserve fund was the best means that they could adopt of meeting expense.

He also said the new cable was not a spare cable; it had been made and paid for by the shareholders. With regard to the price of cables, they were now cheaper than originally. As regarded the division of profits and the use of a reserve fund, he had been all through a zealot for reserve funds. Mr. Newman suggested making up their dividend by the interest on the money when competition arose. He (the Chairman) thought the use of a reserve fund was to renew the plant whenever it required it. The Chairman then put the motion for the adoption of the report, which was carried.

M. C. F. dos Santos Silva (representative of the company at Lisbon) and Mr. Frederick Joule, the retiring directors, were next re-elected, on the proposition of the chairman, seconded by another director.

On the motion of Mr. Newton, the auditors to the company, Mr. Henry Derer and Mr. John Gane were re-elected auditors.

No further questions being asked,

Mr. Houston proposed a vote of thanks to the chairman, and Mr. Warren, in seconding it, remarked that he thought the chairman should introduce the *clôture* there. So many unnecessary questions were asked which had received answers previously that the meeting was made tedious thereby.

THE EASTERN ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

On Tuesday, at the City Terminus Hotel, Cannon Street, the first ordinary general meeting of the shareholders of the above-named company was held under the presidency of Ernest Noel, Esq., chairman of the company.

Mr. Marshall T. Collet having read the notice convening the meeting,

The Chairman said: Gentlemen, I suppose you will take the report as read. It will hardly be necessary for me to read it to you, as it has been for some time in your hands. I will go on the grounds that it is taken as read. The report itself is a very full one, and no doubt is, to a considerable extent, the cause of the very small meeting we have to-day. If shareholders are not informed as to the state of a company they naturally come to the meeting to find out what is said; but it is evident, I think, from the very small number of gentlemen who are present to-day that the report of the directors is so full that they do not think it necessary to attend the meeting. At the same time I must confess that I am sorry that more shareholders are not present, as I should have liked to have explained to a large body of shareholders what the real position of the company is at the present moment. The accounts before you are only made up to the 30th of June, and when you think of the distance that India is from this country, and that our operations are not even confined to India, but to places like the Straits Settlements, still further off, you will understand that it will be impossible for us to bring all points before you accurately beyond a date like June 30th. Still I can tell the meeting somewhat of our position up to a considerably late period, only that would not be absolutely accurate, such as we could publish. I may say that I am of opinion—and I think it is the opinion of the board generally—that what we hoped for some time ago seems more and more likely to become true. I believe there is a very large opening for the industry in which we are engaged. I believe that we may look forward to a very successful trade in the East for lighting. Those of you who have at all followed the course of electric lighting in this country must be fully aware that there have arisen many and grave difficulties as to its application. The mere installations made for experimental purposes were perfect; nothing could be more perfect than what was seen at the Crystal Palace. But the experiment at the Crystal Palace and one which is a practical commercial success are very different things. Every one has seen the difficulties which have arisen in this country. There are very much larger difficulties in India, where the climate is different and the conditions under which you work are very different. Many appliances perfectly useful in England, or for a climate like our own country, would not do abroad, and we had to discover not only what was useful, but what was possible even, in a country under those different climatic influences. But notwithstanding all that — notwithstanding we have had to cope with all the difficulties that English electric engineers had to meet, and our own to boot, we have been making really substantial progress. We have been day by day and month by month overcoming difficulties. I do not say they are all overcome. I do not say we shall not make many and great improvements, for I fully trust we shall. We have advanced so far that we have done that in a degree, and I think we may almost take credit to ourselves beyond, perhaps, any electric lighting company; we have made distinct progress. We have sent out already to India and the East £40,000 worth of electric appliances of all sorts. I do not know whether you would like me to read out these amounts. We have sent £35,000 worth to India to the end of September. I hardly like to trouble so small a meeting with details; but we have sent £12,000 of cable, which I need hardly tell you remains intact. There was £9,000 for dynamos, £5,700 for steam-engines, £5,000 for lamps, £900 for posts, £800 for carbons, £600 for incandescent lamps, £1,200 in various other things. That roughly is the amount of goods sent out, which are at this moment as valuable as when sent out, so that our capital that has been sent forth to different parts of the world remains, though in a different shape, pounds, shillings, and pence. The chief part of that—as you would have seen from that short statement—was for arc lighting. And you may ask, why only consider arc lighting? Considering how much has been spoken of other lighting elsewhere, why only arc lighting? I will speak further on upon that subject in the words I have to say, and I think you will see that the reasons why we have commenced with arc lighting were such as were dictated by wisdom and prudence. We have, already at this moment established in India contracts for about £4,500 a year. That amount is very small compared with what it would have been had not we been interfered with latterly, unfortunately, by the Government. The Government prevented us from carrying overhead wires, the only way in which electric lighting had been carried on profitably until lately. They not only interfered with what we might have done in the future, but interfered with the successful installations which had been put up, under municipal authority, in three different towns, which were arbitrarily stopped by the Government. The Government determined that in the future all installations should be conducted by underground wires. We at once applied ourselves to that. If the Government do not see fit to alter that, which I think they will when they find that the installations we have put up have not the grave dangers attending them which some of their engineers have informed them there is, I think we shall find that there will be a considerable relaxation of the order which is at present in force. In fact, the arguments by which that order was enforced were of such a nature that it is evident a little further knowledge of electric lighting will explode that series of objections. I may, however, be allowed to express the opinion that I am personally favourably inclined towards underground wires, which would, I think, be an advantage both to the company itself and to the population. We applied ourselves diligently to that question. We have got a satisfactory contract for the municipality of Bombay, and we are doing an amount of street lighting which I think you will find it difficult to show elsewhere. With the towns of Broach and Surat we have both good contracts for two years, and they are now successfully lighted up evening by evening. The contract at Broach is at the rate of £50 per lamp, that at Surat slightly under. Both of these contracts are of a paying nature. The ones at Bombay, as they gave so many facilities, we have taken for £1,200 a year for arc lighting, which if not so paying as the later contracts is still one thoroughly satisfactory to the company. There are still other things which I look upon as more satisfactory to our operations. We have got a year's contract for the Kaiser Mill at a very remunerative price—at a fair substantial profit—one that will thoroughly pay the shareholders. The motive-power for the work, which is one of the greatest expenses, is given by the mill itself, and we have only to supply dynamos and lamps, and for that we have charged £28 17s. per lamp per year, an offer which is one that will certainly fairly remunerate us for our capital so employed. What has happened at the Kaiser Mill has already affected two other mills, who finding what we had done there are desirous of having the same advantages, and we are at this moment in communication with them, and I hope for a telegram within a day to say that with those two further mills we have an excellent contract signed. On the Bombay and Baroda railway we have had a temporary installation, showing the advantages of our system. A break having occurred on that line, we were enabled to send down a temporary installation, which enabled the engineers of the line to work by night, so that the line was soon again opened to the public, showing the great value of such an installation; and my belief is that the railway companies will find it is for their own interest to become purchasers of such an amount of plant as will always enable them to supply themselves with light in case of such contingencies. Then, again, we have just heard in the last letter from our managing director in India, we are to light up the Viceroy's camp next month, when there will be 50 of our large arc lamps to light up the Viceroy's and the different Punjab chief's camps; and as this is being done at the expense of the Government, as they are willing to pay for this, and pay us a fair remuneration, I can hardly doubt, myself, that we should find, as the result of that short installation, results as the exhibition of our industry in those parts of the country, which will be highly satisfactory to the shareholders. This is only one part of our great field of operations. Our operations have not been confined to India alone. We early started in Egypt. There were many difficulties to be overcome, and we showed an installation at Cairo waterworks, which was so satisfactory to the people there, that we were about to enter into contracts as to larger works. I need not enter into a political disquisition as to what has taken place in Egypt, neither is it my province to give an opinion as to what will be the future of Egypt, but I think I may say this, that whatever views we have of our present Government, we cannot but believe that Great Britain will not retire from Egypt until she has seen that there is a firm and established government there. If there is a firm and established government in Egypt, all that prosperity will be shared by your company. I have very little doubt myself, that with the establishment of a firm government in Egypt the Eastern Electric Light and Power Company will also find itself firmly established there. Our agent, Mr. Manuk, assures us that he has not the slightest doubt, that when we can show a proper incandescent installation as well as that which we have shown as arc lighting, that the demand will be very much and speedy. We have secured the services of a good engineer, who will very speedily proceed to Egypt, and I trust within a very short time you will see announced in the newspapers that an admirable incandescent installation is to be seen in Egypt—ah! better than that, that it is being taken up largely at profitable prices. Then, again, in Malta. We there commenced a small installation; the first one was at our own expense—rather as an advertisement, and nothing more. After a short time we had a short municipal contract, and have been lighting up the Strada Reale, at Valetta. That contract ends, I think, next month, and our agent there, Mr. Rosenbusch, informs us that there is hardly any doubt that we shall have an enlarged and more perfect contract with the municipal authorities, and also he adds that the demand for incandescent lighting (of which I am very soon going to speak) is very marked and decided. Then we have still further off than India another field which, to my mind, promises exceedingly well. First of all we have a great advantage in the Straits Settlements in having in Mr. Walter Judd, the agent of the Eastern Electric Telegraph Company, a most admirable coadjutor, who is permitted to work part of his time for us. Without again making too many boasts, I think without hesitation I may say that we have seen our way to a good paying business in the colony of Penang. Again I repeat, as I said before—I said it to the shareholders the first time I ever met them, and I hope to keep it always steadily before them—that what we have hoped for in this company is not to make wonderful statements of what we will do, but to bring before you what we have done. You must all know that the difficulties are considerable, but I say we have overcome many of these difficulties, and we come to-day to say, though we have not done all we could wish, we have done a good year's work in establishing good contracts and in showing what can be done in those distant parts, giving us a good earnest of what will be in the future. As there are, of course, unremunerative expenses, I think the board may take credit to themselves that only the sum of £3,625 may be put down as unremunerative expenses, for establishing—for the work of the first year of the company. That is like money spent on a building. The building is not the trade; the trade is carried on in it. You must have a building where you can carry it on. These expenses, when you consider the distances at which we have had to act, the expenses are very small, and are really part of what we regard as capital account, to be dealt with hereafter, for the shareholders to say whether it should be spread over more or less years. It is certainly more of the nature

of capital account than of ordinary revenue. The call which was made—£1 per share—which does not come into this statement, has been well met, and the money so derived is being spent on the inauguration of our incandescent system. And now I am going to say a few words on that system, and perhaps you may say, why have you been so backward, when one has heard so much of what can be done by incandescent lighting? Why be so backward? I think a very few words will explain that. My belief—I hardly again like to speak in the name of the board, but I think I may do so—my belief is that the board consider whilst you can undoubtedly in small instalments make a most perfect show of incandescent lighting direct from the dynamo, that at all events with our system you cannot economically and commercially work it. I believe incandescent lighting cannot be worked in a profitable manner on a large scale direct from dynamos, from the uncertainty of it. Anything happening to your engines, to your dynamos, to your shafting or any part of the machinery, and what is the result? Why, your lighting is all extinguished. In the case of a multitude of small lights the dangers of that and the expense of watching the work closely are so great that in my opinion it would not be done on a large scale commercially. We were convinced in our own system it was impossible. Therefore, storage was absolutely essential—that is to say, that you might have an amount of electricity stored up that you might turn on like water or gas whenever you wanted it. This company has made admirable arrangements with the Indian and Oriental Storage Company which gives us the use of their batteries at the cheapest rate throughout the whole field of our operations. And what does that mean? It means now that we can send out—nay, we have sent out—one of the most perfect installations of incandescent lighting that is to be seen in the world. I believe that that installation, which is now on its way to India, will prove to be ahead of almost anything that has been shown yet. Not that the Storage Company is not showing it. We are only using what they have accomplished. You may see it at their offices at work, and at our own offices, and if any shareholder has not seen the incandescent system in work I ask him to go to our offices and see it, where we have a beautiful and brilliant light. We have now sent out a perfect installation; we shall have more speedily to follow. We are prepared within a very few weeks to send out a good installation to Egypt; we hope very soon—I believe within a very few weeks—to be able to despatch one to Penang, and are looking forward to send one to Malta. Mr. Grindell, our chief electric engineer, starts to-morrow for India. He will superintend the putting up of this installation. Happily, we have such confidence in him that we have not the slightest fear but that that installation will be thoroughly satisfactory both to the people of Bombay as well as to the shareholders of this company One of the greatest difficulties we have had to contend with has been the want of men competent to undertake such work as we have for them to do in those distant countries. I am happy to say we are day by day overcoming that difficulty. More than that, we are going forward. We have in Mr. Grindell a first-rate man; we have others coming forward, and I hope before I have the honour of meeting you next year, we shall be able to say we have a first-rate staff working in the whole of our great Eastern empire. Now I do not wish to boast or to draw over-coloured statements of what we are going to do. I have tried to tell you simply what we have done and what that suggests to me. I believe there is a good future for this company. I believe there is a great future for electric lighting in the East, and I believe the lighting is peculiarly suited to those countries. I believe we have got hold of a system which will secure to us a large portion of this great industry of electric lighting throughout the Eastern world. What we have done is not what we had hoped, because the Government has so seriously interfered with our working in regard to the underground wires. Our managing director tells us that our contracts would have been more than doubled if it had not been for that interference—say ten thousand pounds. Contracts are coming in daily to us, and the demand for incandescent light is such that our agents, through our managing director, tell us that when we can show a really good installation, such as we now can show, that the demands will be more than we can at once carry out. I can only, therefore, say that in my opinion the shareholders of this company have to be congratulated on, what appears to me, a very hopeful prospect. How rapid our progress will be it is not for me to say; what difficulties remain to be overcome I cannot know; but we are determined to face them, and I believe our past experience gives us a right to hope that we shall overcome them all successfully, and be able to show that you were wise in embarking your capital in an undertaking of this kind. I beg now to move the adoption of the report; and I shall be glad to answer any questions which gentlemen may wish to ask.

Mr. Delmege asked whether any progress had been made in regard to electric lighting at Calcutta.

The Chairman said that at this moment they were in communication with a firm there. They had sent dynamos out and lamps, but they were anxious not to commence at Calcutta till they commenced arc and incandescent lighting together, because they believed that incandescent lighting would be chiefly demanded, and they would like to have a complete installation when it was made. He hoped the shareholders would shortly be informed that it had been commenced.

Mr. Delmege said he understood the company had an agent at Ceylon. He came from Ceylon, and he had heard that the company were likely to make a favourable contract there.

The Chairman said it was difficult to speak about things which were in progress. He should not like to speak of anything they were doing in Ceylon, except that they were working there. He must not say anything that would be "injurious to the public interests," as was said in parliamentary language.

Mr. Latimer Clark seconded the motion for the adoption of the report. He concurred in the chairman's remarks, and he could wish that the chairman had spoken even more strongly of the action of the Government in regard to the laying of wires underground. Difficulties were cast in the way of the companies somewhat indiscriminately, and he thought that if they knew all that had been done in that respect, they would almost be ashamed of their countrymen. The loss had been greater to the company than had been explained.

Mr. Gillett said he understood from the chairman that so far the directors were not satisfied with the commercial success of incandescent lighting. Perhaps the impression on his mind could be entirely dissipated—perhaps also from that of others. The remark conveyed this idea to him, that although they might be satisfied with the Brush dynamo for the purposes of arc lighting, yet the board were not satisfied as to the commercial success of it for incandescent lighting. If that were so, it would be a serious thing, not only for this company, but for a number of others. He took it that as they were sending out a quantity of materials for the purpose of establishing incandescent lighting, the remark of the chairman was not to be interpreted quite as he (the speaker) had taken it. Perhaps while he was on his feet he might ask a question for the purpose of clearing the atmosphere:—Whether it was true, as one had read so much of in the papers, that litigation was in view between the several subsidiary companies as to the patents not being worth what they were supposed to be worth. Would the chairman mind telling them the position of this company with regard to those points that had been raised, more especially as to the Lane-Fox patents? He believed it had been stated that the original Brush Company sold what they did not quite possess. He never heard the name of this company as likely to be involved in any litigation—he hoped it would not be—but it might be satisfactory to all present, as well as shareholders not present, if, after the report made in the newspapers, they could hear that everything they had bargained for was perfectly satisfactory.

The Chairman said he was much obliged to Mr. Gillett for calling his attention to that matter, and was sorry he was so blundering in his exposition of incandescent lighting that any such ideas should have come upon Mr. Gillett's mind. What he said, or rather what he intended to say was this, that they were convinced that incandescent lighting direct from the dynamo would not be a commercial success. They were not going to have incandescent lighting directly from the dynamo, but from storage batteries, and through these he believed that incandescent lighting would not only be a commercial success in the whole field of their operations, but would be the very best lighting. In regard to the question asked by Mr. Gillett in reference to threatened litigation elsewhere, he could only say that about this company there could be no question of litigation. They were in a different position from that of any other company, as regarded the parent company, inasmuch as this company were absolute purchasers of the patents for India and part of the East, and were manufacturers. They were not a licensed company; they were an original company, and a manufacturing company, and they had patents. With respect to Mr. Lane-Fox's patents he was not going to give an opinion. He had no reason to doubt that they were good, but if they were not good it was no business of this company, inasmuch as in such a case the money they paid would have to be returned, because the validity of the patents was guaranteed to them.

Mr. Gillett remarked that the shareholders must feel that was very satisfactory for them all to hear, both those who were present and those who were absent. He was very much obliged to the chairman for the explanation.

The motion for the adoption of the report and balance sheet was then put and carried.

Mr. Comberbatch then proposed the re-election of the auditors, Messrs. Deloitte, Dever, Griffiths & Co.

This was seconded by Mr. Paton and carried, and the proceedings concluded.

EXTRAORDINARY MEETING.

At the close of the ordinary meeting an extraordinary meeting was convened for the purpose of passing some resolutions which were essential for Stock Exchange purposes.

The Chairman said he would simply move these resolutions *pro forma*. The first was: Resolved, that articles 171 and 173 be rescinded. He explained that those articles had been objected to by the Stock Exchange, who required that they should be expunged.

The articles were read by the secretary.

Mr. Alderman McArthur, M.P., seconded the resolution.

Mr. Gillett asked for what reason the articles were originally thus drawn?

The chairman explained that at that time it was a standard form usually observed. Articles of association were all alike for most companies. Carried.

The next alteration proposed was to vary article 7, by inserting therein after the word "directors" in line one, the words "and persons thereunto expressly authorised by the board, and acting within the limits of the authority conferred on them by the board."

Mr. McArthur seconded the proposal, and it was adopted

Another alteration proposed was the addition to article 114 of the following words: "No director or officer of the company shall be appointed auditor." Carried.

Next it was proposed to add an article, No. 95a, thus: "Any resolution in writing, signed by all the directors, shall be as valid and effectual as a resolution of the board."

The chairman explained that this was to meet the emergency of being unable to form a quorum when the board were a long way from town, say, in the Autumn; then, if there was any important work necessary to be done, without summoning gentlemen from long distances, a written resolution would be sent round, and when it had been signed by the whole board that might take the place of a board meeting.

This was seconded by Gen. H. D. Abbott, C.B., and adopted.

A vote of thanks to the chairman, proposed by Mr. Gillett, and unanimously adopted, brought the meeting to a close.

THE J. B. ROGERS' ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

The general meeting of this company was held on Tuesday, October 24th, at the offices, 47, Holborn Viaduct, Captain Arthur in the chair.

The Secretary (Mr. F. Wisdom) having read the notice convening the meeting,

The Chairman: Gentlemen, I regret our chairman, Lord Graves, who came to London yesterday in order to be present to-day, through illness is unable to attend. As you are most of you doubtless aware, this is a merely formal meeting, rendered necessary by the Companies Act, and as it is held at so very recent a date after the allotment of shares, you will hardly expect from me a lengthy statement of what we have done. Our first steps have been directed to ascertaining the best means of conducting the business of the company, so as to insure the success we all feel sure awaits its operation, and in that direction our efforts are still tending. Unlike most other electric companies, instead of devoting our time to financial projects, our energies are directed to preparing means to enable us to proceed immediately to the promotion of practical electric lighting, and we are now in a position to undertake contracts for such purpose. We purpose at the termination of the lease of these premises to remove to others less expensive, but better adapted to manufacturing purposes, as we are of opinion that from such the greatest profit will accrue. We are in negotiation for several contracts, of which it would be indiscreet of me to mention the particulars, but we are hopeful of success in more than one instance. We have during the past month had a most successful exhibition of the light at Reading, which was a public trial of no mean order, details of which Mr. Rogers, in whose hand the whole management has been, will now give you.

Mr. Rogers: Well, the operations at Reading have extended to this: within ten hours we had 40 lights, next day we had 105, and then something like 136, and afterwards 189, giving 10 horse-power. (?) I think that is about as much as you can expect from such a trial under the circumstances. We had merely an engine on wheels, nothing fixed, and I believe it was giving great satisfaction in the place. I have since moved to the back of the Town Hall. The town authorities entertain the proposition of lighting up the Town Hall, but it must come before the Council, which meets on Tuesday, November 7th. Well, I lit up the Abbey in the first place, and the Hall, that is, the Abbey Hotel. I also lit up the Ship Hotel and the *Mercury* Office, and gave off lights in two or three shops in the neighbourhood on Saturday night. I also lit up the Queen's Hotel Banqueting Hall, where the Corporation had their annual banquet. You are quite aware this is only merely to demonstrate the fact that the light is practical, and was giving the greatest satisfaction in Reading. Another thing, I think, that is done for about one-eighth (?) per cent. less than was spent by another company in carrying, or attempting to carry, what we have in Reading. I think we are doing the best we can with the means at our command.

A Shareholder: One of our directors present, I understand, has been to Reading; he may be able to give us a few details.

Colonel Liebenrood: I do not intend to go into details, I simply want to state to you that I have been down there constantly while the experiments have been going on, as I reside in the neighbourhood. I have had facilities for hearing from various sources, either good or bad, opinions of the different people in the locality, and I can tell you that in every single instance, and I have tried in all parts, parts where I have been unknown to have any connection with the company, and I have found on all sides the highest opinions, everybody who has seen the light speaks of it as the greatest success they have ever seen connected with electric lighting. I feel quite sure it was a very severe test, because we had to distribute the light over an hotel of three flats, that is a severe test on the distribution of an electrical current, particularly as it is away from our main works and in a new field. If we succeed here I will have greater faith in the incandescent than I ever had before. At this exhibition I can say there was not a failure of any kind, and we are told that everybody in the place speaks highly of the light. One or two other companies have tried in the same field before and failed, and they put it down to a want of power. We have succeeded, and therefore we gain all the more credit in having done so.

The meeting was then made special, when the following resolution was put and carried:—That the following article be substituted for article No. 95 of the Articles of Association of the company:—"95.—Notwithstanding any of the clauses herein contained, the directors may from time to time as and when the patents and inventions of the company or any licences to use the same shall be sold or disposed of, or granted for any consideration other than the payment of annual royalties, distribute the said consideration among the members in proportion to their interests in the capital of the company (as nearly as may be), except that the deferred shareholders in case the dividend mentioned in article 86, sub sec. 1, shall have been duly paid or provided for, shall be entitled to a distribution of one-third of such consideration amongst them in the proportion aforesaid, and the preferred shareholders shall be entitled to the remaining two-thirds of such consideration for distribution amongst them in the like proportion. For the purposes of enabling such distribution to be made the directors shall be at liberty to sell or realise any part of such consideration which cannot be distributed except by means of a sale, and in the event of any of the members either declining or being unable to accept the proportion of any consideration (other than cash) to which they shall be entitled, the directors may sell or realise the same at their discretion, and pay the net proceeds to such members."

Mr. Martin Wood proposed a vote of thanks to the chairman, which was seconded and carried unanimously.

The Chairman: I thank you, gentlemen, and hope the next time we meet we may have something more to communicate to you.

The proceedings then terminated.

The West Coast of America Telegraph Company.—We are informed that communication by this company's cable between Lima and Mollendo was restored on the 30th ult., and that messages can now be sent through the Atlantic Cable Companies, *viâ* Galveston, direct to Valparaiso and elsewhere in Chili and the Argentine Republic.

Central and South American Telegraph Company.—Telegraphic communication with Valparaiso, Panama, Buenaventura, Payta, Lima, Mollendo, Arica, Iquique, Antofagasta, and all telegraph stations in Peru and Chili, is now established, *viâ* New York and Mexico.

The Birmingham and Warwickshire (Brush) Electric Light Company.—Mr. David Evans, C.C., has retired from the board of this company.

Application has been made to the Stock Exchange Committee to appoint a special settling day in the following securities:—London and Globe Telephone and Maintenance Company (Limited), shares; London and Provincial Electric Light and Power Company (Limited), shares.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Quotations Nov. 2 1 O'clock.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9¾-10¼	9½¾⅞10⅛ ⅛¼⅜½
		Do. Do.	10	18 - 23	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1¼- 1¾	1⅜
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	¾- 1¼	
25,000	5	Great Western Electric Light & Power Co.	2½	¾- 1¼	1$\frac{1}{16}$
24,980	5	Hammond Electric Light & Power Supply Co.	2½	5 -5¼	5,$\frac{1}{16}$,⅛,¼
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1¼- 1¾	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- ¾	½
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1½- 2	
..	..	South African Brush Electric Light & Power Co.	2½	¾- 1¼	
100,000	5	Swan United Electric Light Co., Limited	2	1¾- 2¼	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49½- 50½	49¾
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	80½- 81½	81.80½
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19 - 20	
130,000	10	Brazilian Submarine, Limited	10	12 -12½	12¾
16,000	10	Cuba, Limited	10	9¾- 10¼	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	15½
65,000	20	Direct United States Cable, Limited, 1877	20	11⅝- 11⅞	11¾.12.11⅞
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10½-10¾	10⅝,$\frac{9}{16}$,$\frac{11}{16}$
70,000	10	Do. 6 per cent. Preference	10	12¾- 13¼	13.12$\frac{7}{16}$
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -105	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½- 11¾	11⅝
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	10⅛.9¾
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6⅝,¾ xd.
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	12¾ xd.
125,000	10	Great Northern	10	12½- 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	..	
100,000	100	Do. 6 per cent. Debentures, 1886	100	..	
17,000	25	Indo-European, Limited	25	30½- 31½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 4¾	
12,000	10	Mediterranean Extension, Limited	10	1¾- 2¼	
8,200	10	Do. 8 per cent. Preference	10	8 9	
9,000	8	Reuter's, Limited	8	12½- 13	
280,000	Stk.	Submarine	100	245 -255	
58,225	1	Do. Scrip	1	2¼- 2½	
4,200	Cert.	Submarine Cables Trust	100	101 -106	104½
37,350	12	Telegraph Construction and Maintenance	12	33½- 34½	33⅞.4
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛- 1½	
30,000	10	West Coast of America, Limited	10	4½- 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7¼- 7¾	7$\frac{7}{16}$
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5½- 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	1$\frac{1}{16}$
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	½- ¾	⅝.$\frac{11}{16}$
100,000	5	United Telephone Co.	5	10½- 11½	

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending 20th October, 1882, were £2,633; and for the week ending 27th October, 1882, were £2,365, both after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 30th September are £1,722, as compared with £1,616 in the corresponding period of 1881. The estimated receipts for 15th October are £1,605, as compared with £1,693 in 1881.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 259.

THE ELECTRIC LIGHTING ACT.

THE question of electric lighting is just now probably the most important of any demanding the serious consideration of the Vestries. Applications are coming in on all sides from companies, each desirous of being first in the field, and vestrymen are called upon to decide a matter about which the majority have no technical knowledge whatsoever.

The local authorities appear to be fully aware of the importance the subject demands, and they will of course deal more with the commercial aspect of the matter than with the scientific. It is, however, much to be regretted that so few of those who will be responsible for the decisions arrived at should have made themselves acquainted with the technical details of the question. The most important movement instituted in connection with electric lighting in London is the combined action of the South London parochial authorities, which took the form of a conference on Tuesday, the 31st ult. The meeting was called together by the Camberwell Vestry, and was held under the presidency of Mr. E. Dresser Rogers, at the Peckham Vestry Hall.

In opening the proceedings, Mr. Rogers remarked that the conference had been called together to decide as to what course it was advisable to adopt with reference to the electric light. Many difficulties and troubles were entailed by the action of the gas and water companies, and although he was not going to say a word against those bodies, he hoped the conference would endeavour to lay down some general scheme or principle with regard to the new light which would prevent a renewal of the difficulties he referred to. It would be seen, from a perusal of the Act of Parliament, that the Legislature had clearly shown a disposition to enable the local authorities themselves to supply the light, if they thought it necessary, and this conference would doubtless have the effect of arriving at some general principle whereby the Act might be carried out on the best possible terms, so far as the ratepayers were concerned.

Mr. A. Middlemass (Camberwell) moved :—"That it appears to this conference to be expedient that the control of electric lighting should be in the hands of vestries and district boards, as the local authorities named in the Act, by licences or provisional orders, to be obtained in the exercise of their discretion." He said that primarily what the delegates had to consider was, not the scientific details with regard to the question of the electric light, but the effect of the management, which was likely to fall into the hands of the vestries and district boards at their option.

This was seconded by another Camberwell representative, and after a long discussion, carried on by the delegates of nearly all the South London Vestries, Mr. Scovell (St. Olave's Board of Works) said he could not agree with the resolution, and moved, as an amendment, "That in the absence of more full and precise information than is at present possessed by the public as to the probable cost of electric lighting, the South London vestries and district boards petition the Board of Trade not to sanction any provisional orders to companies for South London until the result of longer experience be before them."

Mr. J. Tolhurst read a letter from one of the electric lighting companies offering to light a district at a price which, worked out, would be £31 less than was now paid for gas.

Eventually both the motion and the amendment were withdrawn ; and the conference was adjourned.

This meeting cannot be said to show a very satisfactory result, but perhaps as the subject was so little understood it was a wise course not to enter further into the matter at present. At the usual meeting of the Newington Vestry, held on the following day, a decision was arrived at which will be of a much more satisfactory character to all interested in the immediate development of the electric light.

Mr. Marsland, in moving "That the vestry apply to the Board of Trade for a licence, under Section 3 of the Electric Lighting Act of 1882, for the supply of electricity for lighting purposes, both public and private, within the area of the parish of Newington," advocated that they should take out a licence. The principle of the Act was that the local authorities should be empowered to adopt for themselves the principle of electric light, and apply it in the same manner in which companies would, and in the same manner in which the latter had applied gas and water. The committee specially appointed to make a report on the question were not prepared at the present time to tell them anything accurate with regard to the cost. The resolution merely asked them to put themselves in this position—they would apply to the Legislature for power to take up a licence as soon as possible. They would get their licence, and proceed by steps the same as any other company, and there was no doubt they would have as much facility for proceeding with their work as a company. The question was discussed as to what would be best—to apply for a provisional order or licence ; and the committee came to the determination that a licence would be the cheapest way of going to work.

A Mr. Tilling said that while appreciating the electric light, and hoping that it might turn out a very great boon, he was not yet convinced that it would be successful for the lighting of streets. They had not yet learned the cost, and the report was very far from giving them conclusive information on this point.

After considerable discussion the resolution was adopted by a majority of 24, 42 gentlemen taking part in the vote.

Although this decision may be looked upon as favourable in one sense, the threatened appropriation of electric lighting installations by the vestries themselves will certainly delay the general adoption of the light. The local authorities are almost unanimously agreed that they will either have nothing to do with lighting by electricity or keep the means of supplying it to themselves. What the companies will do under these circumstances it is impossible to foretell. It is likely, however, that the vestries deciding to apply the electric light for themselves will find themselves heavy losers by the transaction. As the *Pall Mall Gazette* well points out, "Electric lighting is as yet in an experimental stage. It is not for municipalities to use the money of the ratepayers in conducting experiments in electric lighting. They

might enter into contracts and expend hundreds of thousands of pounds only to discover when all was done that their money had been wasted. At present electric lighting is eminently a speculative undertaking. No one can speak positively either about the cost of installation or the cost of working. Still less can any one predict the probable profit on capital expended. Another and still more important point is that arising from the difference between the licence of a company and the exclusive licence of a municipality. A company can receive a licence for any limited area however small, but the corporations which demand exclusive powers include the whole area under their jurisdiction within their licence. One of the conditions of an electric light licence is that all persons within the specified area must be supplied at the same price, and no undue preference may be shown to any one. Under this clause, if a corporation secured what we may call an exclusive licence, covering the whole area of its jurisdiction, it could not supply a single district until it was prepared to supply every outlying suburb. This, of course, is fatal to any experimentalising except on the largest and most costly scale."

We quite agree with our contemporary that it would be wiser that municipalities desiring to give the electric light a fair trial should give a licence to as many different companies with as many different systems as possible and let the results decide the question. In the mean time electric lighting is at a standstill, and already petitions for the winding-up of recently-formed companies are abroad. We believe, however, that sufficient demands of a private nature will be made upon the resources of those existing companies with well proved systems to enable them to declare a dividend to their shareholders, and that such demands will be continually on the increase as the benefits derived from the employment of the electric light become more widely known and appreciated in mills, factories, and places of like character.

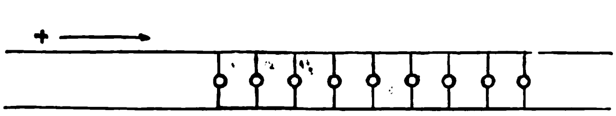
INCANDESCENCE LAMPS ON ARC CIRCUITS.

By A CORRESPONDENT.

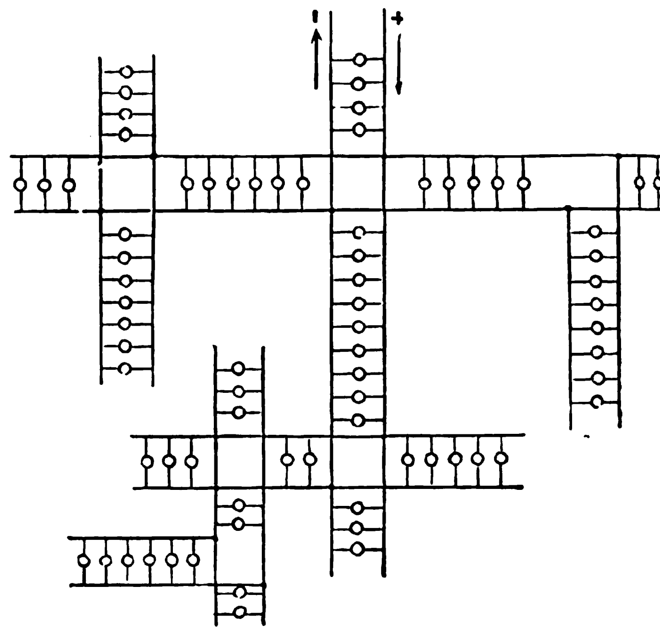
In several systems of electric lighting it is advertised as an economic advantage that arc and incandescence lamps can be worked on one and the same circuit, each being fed from the same dynamo.

Notably is this so in the Brush system, as illustrated at Chesterfield, and it is set forth as of value by the Hammond company in connection with the Ferranti machine. There are, however, several marked disadvantages in connection therewith, apparently overlooked, to which it is desirable to draw attention.

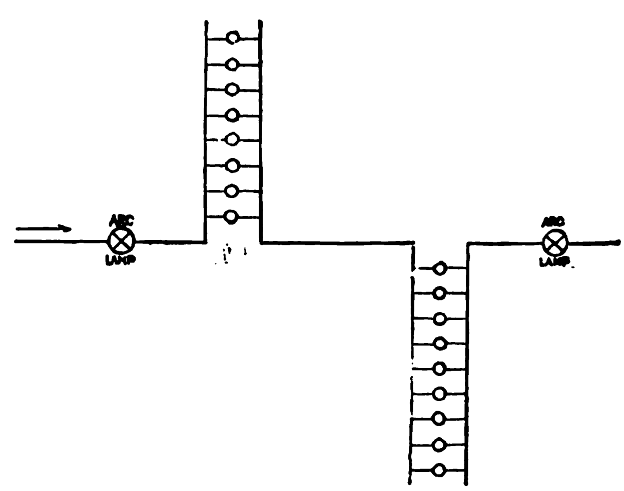
First referring specially to the difficulty experienced in forming the circuit, and secondly to the fact that the fluctuation of the arc lights must, and does, cause variations in the smaller lamps. With ordinary incandescence lighting two main wires are run thus:



and from these leads are carried to wherever lamps are wanted. The cross-connections are easy, and simple to trace, as shown by the following diagram.



But in the case of the arc with incandescence lamps, we have a limit put upon the number of lights which can be placed in a given neighbourhood upon a pair of wires, as we have arc lights in series; and therefore whilst working the incandescence lamps in multiple arc, or parallels, such parallels must be in series and can only feed, at the outside, say, ten lamps, more often only seven or eight, thus:



If, however, for the sake of illustration, it is assumed that ten lamps can be lit on a parallel, and there should be some twelve or thirteen lamps required in the immediate locality, it will be necessary to run a separate parallel upon which to place them, and others to make up the required number may be a good distance off. This adds to the cost of construction, and increases the amount of wire and other stores required; whereas with the ordinary simple multiple arc system lamps can be added at a trifling additional outlay. It will also be seen that it requires no little skill in the arrangement of the parallels, even after a thorough knowledge has been obtained of the requirements of each particular locality.

A further disadvantage in these numerous parallels lies in the fact that a special precautionary arrangement has to b[illegible] made against damage on account of any of the lamps beco[illegible]ing broken. In such a case when one lamp [illegible] remaining nine on the parallel absorb between them the [illegible]rent previously taken by the tenth, which in the case of a [illegible] filament in one of them would probably destroy it. [illegible] easy to see that in such an event those remaining w[illegible] very severely tried, and it has been known that when t[illegible] gone the others have quickly followed, resulting n[illegible] the loss of the lamps on that parallel but the st[illegible] the whole circuit. What are known as "cut outs[illegible]

as many pounds each as the lamps cost shillings—have to be provided for each parallel, and so adjusted that when more current passes than will do for about eight lamps, it short-circuits itself and sends the extra current on to the main line to be, in turn, divided amongst the arcs and parallels.

On a simple multiple-arc circuit, with a few hundred incandescence lamps burning, or even one hundred, the going out of one increases the current by 1-100th only for the remainder, which is very trifling indeed when compared with 1-10th on the foregoing parallels. Thus the incandescent lamps working with arcs have to contend with :—

Unsteadiness of the arc lamps; difficulty in arranging parallels, with extra cost and liability to greater damage (and consequent shorter life) from the breakage of other lamps, and the shunting of extra current beyond what it is fitted to take.

Chesterfield lighting is handicapped in this way, and if Cleethorpes is to be lighted on the same principle, as intimated in a previous number of the ELECTRICAL REVIEW, a similar result must be looked for. Hence one fails to see how arc and incandescence lamps on the same circuit can be economical.

TRANSMISSION OF POWER TO A GREAT DISTANCE ON AN ORDINARY TELEGRAPH WIRE.

(Some Remarks on the Experiments of M. MARCEL DEPREZ at Munich.)

IN the last number was published an abstract of a paper laid before the Académie des Sciences of Paris by the author himself, and recorded in the *Comptes Rendus* of October 9th. This paper in some parts requires some observations which ought to be presented to the readers of the ELECTRICAL REVIEW, being sure beforehand that the discussion which these observations may provoke will throw light on the subject and will bring out the truth.

The first observation relates to the mode of calculation of the return adopted by M. Marcel Deprez, and which can be formulated in these terms: In a transmission of power made by means of two similar dynamo-electric machines, the return is equal to the ratio of the speeds.

It is by applying this principle that one finds a return greater than 60 per cent. in the experiments of Miesbach-Munich, setting aside passive resistance of all kind. This reserve is incomplete, and, it should be added, by neglecting also all the electrical losses which render the principle not applicable to the experiment at Munich: this is what is about to be demonstrated.

In the case of a line of which the insulation is almost theoretically perfect—that, for example, of a short line and of a feeble electromotive force—the principle is correct. In fact, let I be the intensity of the current, the same at all parts of the circuit; E the electromotive force developed by the generating machine, and E^1 the counter-electromotive force developed by the receiving machine or motor.

The power *expended* by the generator will be equal to E I. The power *produced* by the receiver will be equal to E^1 I, and the *return* will be equal to $\frac{E^1}{E}$ or to $\frac{n^1}{n}$ designating respectively by n and n^1 the speed of the generator and receiver, identical in construction, and whose inductors are traversed by equal currents. It is quite different at Munich, by reason of the losses by leakage upon the line of 114 kilometres long, the intensity of the current which traverses the generator is *greater* than that which traverses the receiver. There results from this enfeeblement of the intensity of the current which traverses the receiver a diminution of intensity of the magnetic field formed by its inductors, and in consequence a counter-electromotive force E^1 *less* for a given speed, than that assigned by theory in the case of a perfect insulation of the line.

The power produced, for an expenditure of power given the generator, is therefore always lower than the theoretical value, in consequence of the diminution of the factors, E' and I; the leakage produces the enfeeblement of I in the receiver, and this enfeeblement reacts in its turn upon the counter-electromotive force developed at a given speed to diminish its value.

It is seen, therefore, after what we have just said, that the leakage of the line (and we know on telegraphic lines that this cannot be neglected) does not allow of calculations of the return for the transmission of power to a distance by the ratio of the speeds, even when the machines are perfectly identical.

It is in machines of high tension that the principle gets farthest from the truth, and it is especially with these that one must only accept it with the greatest caution. When the machines cease to be perfectly identical, and this frequently happens by bad insulation or contact, especially in machines with fine wire, of course one can no longer base any calculation upon the ratio of the speeds; in some cases even—the fact occurred in a transmission of power at Montceau-les-Mines—the receiver turned *more quickly* than the generator; the return would be, therefore, *greater than unity*, which is absurd. The ratio of the speeds is therefore, as is seen, a most uncertain element in general, and specially incorrect in the case of the experiment at Miesbach and Munich for calculating the return of the transmission. It would have been preferable to give the power actually expended in driving the generator established at Miesbach, but it seems that the dynamometrical apparatus intended for these measurements was discarded from the first trials.

The only elements that we know of up to the present for determining the return allows one to assert that this return is under 60 per cent., even without considering the passive resistances. In fact, we know, according to the paper in *Comptes Rendus*, that the total resistance of the circuit was 1,890 ohms, which is divided thus :—

Resistance of the generator	470 ohms
Resistance of the receiver	470 „
Resistance of the line	950 „
Total...	1,890 „

On the other hand, M. Frank Geraldy, a witness of the experiment, informed us in *La Lumière Electrique* (October 28th, 1882), that the intensity of the current was 0·4 ampères.

By accepting these figures, and the hypothesis of a perfect insulation, which evidently constitutes the most favourable condition, we find that the energy expended by the heating of the wire, calculated according to Joule's law, is equivalent in kilogrammetres to

$$\frac{I^2 R}{9{\cdot}81} = \frac{0{\cdot}4^2 \times 1890}{9{\cdot}81} = 31 \text{ kilogrammetres per second.}$$

The power expended upon the generator must be at least equal to the power obtained, plus the heating of the line and of the machines. The power produced by the receiver being 38 kilogrammetres per second, the power expended by the generator is, therefore, at least equal to 38 + 31, or 69 kilogrammetres per second, and the return consequently cannot exceed 38-69ths, or 55 per cent., by the most favourable hypothesis.

These remarks are not intended to diminish the very great interest of M. Marcel Deprez's experiments, they are only to put in relief the incompatibilities which the high figures which have been published, hitherto, upon the Miesbach and Munich experiment present, and to show that the proportion between the return and the relation of speeds does not apply at all to the transmission of power to a great distance.

We await with great interest the official report of the Commission, which will let us know to what extent it is best to reduce the original figures.

E. HOSPITALIER.

RAILWAY INTERCOMMUNICATION.—The recent lamentable loss of life through the fire which occurred in a Pullman car should act as an additional incentive to the employment of electrical apparatus for signalling between passengers, guards, and engine-drivers. The mechanical arrangement with the outside cord, adopted by some railway companies, is certainly useless in an emergency, and the inside one is but little better. The closed circuit principle is the best adapted for such purposes.

BERTHOUD, BOREL AND CO.'S ELECTRIC CABLES.

SINCE M. Borel first introduced his system of lead-covered insulated cables, he has effected very considerable improvements in their manufacture, so that the invention in its present state leaves but little to be desired, though the result of the "time" tests has yet to be seen. The original process of manufacture consisted in drawing down the conductor, insulator, and protective lead covering at one operation. The conductor in this description of cable was formed of lead, as was also the outer protective coating, whilst the insulating material was formed of sulphur or resin; the latter was crushed to a powder by the process of drawing down. We gave a description of this cable in the number of the Review for April 1st, 1879. Experience, however, proved that the arrangement did not give permanently satisfactory results, as the crushed insulator was naturally of an unstable nature, whilst the conductor, which was necessarily of lead in order to render the drawing process possible, had too high a resistance for general requirements.

Generally speaking the present form of cable consists of a copper conductor, covered with cotton, saturated with hot paraffine-wax, the whole being closely encased in a protective lead covering. This arrangement is not in itself new; about ten or twelve years ago a similar form of cable was invented, and we believe, patented by a Mr. Marshall. The cable was formed of a lead tube in which the cotton-covered wire was drawn, hot paraffine-wax being afterwards forced in the pipe under pressure. A length of this cable was laid across Windsor Park (in a clay soil) in connection with a private telegraph wire, but after being down for some months it failed, and on examination the lead covering was found to have become completely decayed in several places, thus letting in moisture and destroying the insulation. Mechanically this cable was correct in principle, since it might be hammered out flat without injury to the insulating covering, but its liability to decay rendered its use impracticable. Although Marshall's paraffine cable was similar in general principle to that of Messrs. Berthoud, Borel & Co., the system of manufacture adopted by the latter firm enables a very much better article to be produced. In this process, the copper core, insulating material, and lead sheathing, are brought together, and intimately united during the process of manufacture so as to form an inseparable whole.

The machine for the manufacture is very compact, and is all contained within four columns surmounted by a circular platform, which is accessible by means of a ladder. On the platform is a small boiler surrounded by a crown of gas jets. Into the boiler full of melted paraffine and "colophane," the copper wire covered with its treated cotton covering is introduced. A large vertical, hollow cylinder of steel, supported by four columns, stands within the platform. It is into this cylinder, or reservoir, that the ingot of lead destined to cover the cable is introduced. A steel piston can penetrate the cavity of this upper reservoir, from below upwards, forced by water under compression, as in a hydraulic press. The piston has an internal bore like a gun barrel. A tube of steel, terminated by a conical portion, descends through the cylindrical reservoir to the upper face of the piston. It enters a little way into the cylindrical cavity of the piston in such a manner as to leave between the sides of this cavity and its conical portion a narrow annular space. The steel tube is always maintained in this position. The cotton-covered copper wire, and the melted insulating material in the boiler, penetrate together into the cylindrical steel tube. The covered wire is penetrated by the molten insulating material, and wire and insulating material pass out through the conical part of the tube. The piston now rising, exerts force against the lead in the cylindrical reservoir. The metal is displaced and forced through the annular opening left free between the central tube and the inner sides of the piston. The lead surrounds the insulated wire, and encloses it in a metal sheathing. In proportion as the piston continues to rise the lead flows, forcing under it the already formed sheathing, which, of itself, draws in the wire in its downward movement. The lead covered cable leaves the interior of the piston, and emerges by a lateral opening, rolling itself automatically upon a bobbin ready to receive it. The thickness of the envelope of lead is variable at will. It depends solely upon the breadth of the annular space between the central tubes and the sides of the hollow piston. The covered wire, with its insulating material, can therefore be enclosed in metallic sheathing as thick or as thin as one pleases. Each machine can easily turn out 30 yards of cable per minute. The company which works the system of Berthoud and Borel has established a factory in Paris, and another at Cortaillod, in Switzerland.

When the cables have to be laid underground they are passed through the lead press a second time to cover them with a second sheathing of lead. Between the two sheathings an impermeable substance is interposed, such as gas-tar. With this triple protection, the new cables are said to defy changes of temperature and the effects of weather.

At the Paris International Electric Exhibition the Société Jablochkoff used these cables for their electric candles, and for their various machines. Nearly ten miles of these cables were employed for the transmission of force and light in different parts of the Exhibition building; 5,000 metres have since been laid down by the Société Jablochkoff for the lighting of the Opera. A cable with several conductors, placed in the Paris sewers, connected the Ministry of Telegraphs with the Exhibition. Several kilometres have also been laid down in the sewers for telephonic transmission.

The inventors insist upon the fact that the insulation obtained by their process excels that given by either gutta-percha or india-rubber, and in addition the electrostatic capacity is much less than that of gutta-percha. The advantages of low electrostatic capacity are of course considerable, but we would once more point out what we have so often drawn attention to, viz., that *high* insulation, or perhaps we should say high *specific* insulation, is no advantage whatever. A wire which has an insulation resistance of 10 megohms per mile is greatly to be preferred to one which has an insulation resistance of 1,000 megohms per mile, *provided this low value is due to the nature of the material and not to a defect in it.* The aim of manufacturers should be not to obtain as *high* a specific insulation, but as *low* a specific insulation as possible. The statement which appears in the prospectus of every firm or company who have to deal with insulated wire, to the effect that their manufactures are remarkable for their high insulating properties may perhaps go down with the general and with the quasi-scientific public, but it is none the less absurd on that account.

Although the fact of the cables of Messrs. Berthoud, Borel and Company having a high insulating value has no great weight, yet we think that the very perfect and complete way in which their manufacture is carried on is a great recommendation in their favour, whilst their cheapness must tell very considerably when we consider the continually increasing price of the insulating materials in general use.

ON UNDULATORY CURRENTS.

[We translate the following article from our contemporary *La Lumière Electrique*.]

IF undulatory currents are not to the taste of certain scientific writers, who, merely casting a superficial glance at the work effected by them, make statements which are quite the reverse of those advanced by the experimentalists, we can only wonder at the simplicity of such writers, who, without forming a clear idea of their subject, believe that undulatory currents are produced solely by carbon interrupters and not by metallic ones; which leads them to the conclusion that, since speech can be reproduced by the latter, it is not by means of undulatory currents, and consequently, that all the ideas formed as to the mode of action of microphones are so many "mare's nests." We should not have referred to these errors but for the fact that the name of Mr. Preece, a very learned and highly esteemed scienti[illegible] has been brought in in connection with them, alth[illegible] has never supported such a theory any more [illegible] Silvanus Thompson, whose champions these wri[illegible] have constituted themselves. These *savants* and [illegible] whoever they may be, know perfectly well, and [illegible] on all occasions, that articulate sounds can [illegible]

mitted electrically on the condition that the current should be always closed, and that its intensity should vary in proportion to the sonorous vibrations determined by the voice. Now a continuous current, which presents alternations of increase and decrease of power, is really an undulatory current, *i.e.*, a current the intensity of which undulates like the waves produced on the surface of water when a stone is thrown in; it is on account of this resemblance that Mr. Bell has given to the currents transmitted through the telephone the name of undulatory currents. Now, M. Th. du Moncel showed, in 1856, that such currents can be obtained, either with metallic interrupters or with interrupters consisting of bodies of moderate conductivity. If the writer to whom we allude had given any thought to the discussion which has taken place between Prof. Silvanus Thompson and M. Th. du Moncel, he would have seen that the point at issue was this: M. du Moncel is of opinion that the undulatory currents resulting from the metallic interrupters are not sufficient to establish regular transmission of speech in the receivers constructed for loud speaking, since the extent of the variations in intensity of the current caused by the sound-waves of the voice is, according to his experiments, much smaller with the metallic interrupters than the carbon one, or, in other words, that the undulatory currents are much less marked in one case than in the other.

As to the question of knowing whether currents completely interrupted can reproduce speech, there is no electrician who can answer it; but it is known to all that these interrupted currents act much more powerfully and produce, in the case of telephones, loud sounds, heard at a distance, and all over a large hall. The two modes of action can be tested by working the singing condenser of MM. Pollard and Garnier. When the transmitter is regulated so as to reproduce speech, *i.e.*, with the plates of the interrupter in continuous contact, no sound is heard, that is, unless we use the means employed by Messrs. Dunand, Herz, or Dolbear, but if it is regulated so that the current should be interrupted, the apparatus reproduces musical sounds, without transmitting speech.

Prof. Silvanus Thompson asserts, on the contrary, that the metallic interrupters are quite as efficacious as the others, from the point of view of determined undulatory currents, and that the carbon interrupters are only preferable because they do not become oxidised by the passage of the discharge.

We will now give the reasons which prevent M. Th. du Moncel from accepting Prof. Silvanus Thompson's opinion, but we should now say that Mr. Preece has entered into the discussion only to point out the intervention of a new cause in the creation of the undulatory currents produced in the microphone. Far from denying the undulatory currents, he admits them, but he thinks that it is to the calorific action determined by the current at the point of contact of the two surfaces of the interrupter that the effect must chiefly be attributed, whereas it has hitherto been asserted that it must be accounted for by the differences of pressure, the closeness of contact between the two parts of the interrupter, or to the variations in extent of the section of the conductor at the point of contact, in consequence of irregularities in the two surfaces in contact. In opposition to Prof. Thompson's opinion, he maintains that carbon is preferable for this kind of interrupter, because it is of moderate conductivity. M. Th. du Moncel quite endorses Mr. Preece's opinion, but thinks that all the influences that we have just enumerated are at work simultaneously, to a greater or less degree, and that the predominance of any one of them depends on the nature of the microphone.

In the soft carbon microphones, like those of Edison, the predominating influences are evidently the variations of pressure, of closeness of contact, and of section; in the hard carbon instruments it is probable that the cause indicated by Mr. Preece is the most important. However this may be, and whatever importance is attached to the cause at work, the effects produced are always the same.

As to the superiority of the interrupters consisting of bodies of moderate conductivity, which M. Th. du Moncel attributes to the greater amplitude of the variations in intensity of current produced in them, he explains it in the following manner:—(1) "If we start with Mr. Preece's theory, we may say that the points of contact of the microphone becoming heated more easily as their resistance is greater, the variation in the intensity of the current should be greater with bodies of moderate conductivity than with metallic ones, since they offer greater resistance, and besides, as in bodies of moderate conductivity the variations in resistance under the influence of heat are much greater than in metals, the waves of the undulatory current produced by them must be more marked, all the more so because the variation is effected in a more favourable manner, since the effect produced by the sound-waves is to increase the conductivity of the points of contact, instead of diminishing them, as with metals; (2) if we start from the hypothesis of the increase of conductivity effected by the drawing together of the conducting molecules, or by the increase of section, it can be reasoned out in the same manner, for the subsidence of the molecules will be effected more easily in bodies of moderate hardness than in really hard substances, and besides, in the former there are always semi-conducting particles which greatly facilitate the action, as has been shown by the experiments of Mr. Hughes, M. Bourseul, and many others." We cannot attach much importance to the oxidising action of the contacts with the metallic interrupters referred to by Prof. S. Thompson, for according to the experiments of M. du Moncel and Mr. Hughes, the variations in intensity of current are much greater with oxidised conductors than with surfaces that have been scraped; besides, M. Herz's best microphones are those formed of conductors composed of agglomerations of metallic filings. It is therefore perfectly clear that Prof. Thompson's arguments cannot be considered as final.

OBJECTIONS OF A MECHANICAL ORDER TO THE PRESENT THEORY OF ELECTRICITY.

By M. A. LEDIEU.

I. The introduction into the Navy of powerful electric machines has led me to seek a connection between the theory of these machines and that which I have given for heat engines in accordance with experimental thermodynamics. But I have at once found myself confronted by inextricable difficulties, the outcome of the received principles of electrical science.

Further. According to the opinion of physicists and still more of electrical engineers, this science presents to the mind many confused ideas, especially in its later extensions. At its outset, in the first quarter of this century, it formed with the fundamental hypothesis of two fluids, or of a single fluid, a body of doctrine fictitious, but perfectly coherent, both in its points of departure, which in spite of the obscurity of their nature were distinctly defined, and in its context, which allowed of a system of statics *sui generis*.

The discovery of the battery involved, about 1820, the creation of kinetic electricity, comprising at first the laws of the reciprocal actions of currents upon magnets and upon each other, and some years later the laws of their propagation. This new body of knowledge was still based upon the hypothesis of one or two fluids, but it constituted a branch distinct from the former and having a homogeneity of its own, in virtue of its special points of departure and of its peculiar mechanics.

It was soon proposed to effect the fusion of the two imaginary theories in question; then, under the influence of the progress of thermodynamics, the fruitful and real notion of energy was introduced. Unfortunately in effecting these combinations we preserved the ideas and the formulæ already acquired, in place of resuming the whole of the questions from a new point of view. Hence the two specific mechanics mentioned above are found blended both with each other and with the principles of true mechanics. There has thus resulted a doctrine heterogeneous and in danger of displaying incontestable dynamical contradictions.

II. Our principal objections relate to the now classical notion of electromotive forces, whether partial or total, and to that of electric currents, which play a capital and incessant part in the science.

The partial electromotive force is understood of the force which is exerted upon the unity of the electric mass situate at a given point of a field of the kind, and resulting from all the actions of the electric system in question upon this mass.

According to a known demonstration of *static* electricity, it has for its expression $-\frac{d\,\text{v}}{d\,n}$, *i.e.*, the derivative of the potential, v, of the contrary sign taken with reference to the co-ordinate, n, directed according to the normal at the surface of equal potential or of level passing by the point in question; if further, it acts according to the same normal.

On the other hand in *kinetic* electricity, the law of Ohm, as interpreted by Kirchhoff, substituting the idea of potential for that of tension, is summed up in the most general manner in the differential equation—

$$(1) \qquad d\,i = a\,\frac{d\,\text{v}}{d\,n}\,d\,\text{s}.$$

Here $d\,i$ represents the differential of the intensity of the current at a given moment, and in a determined point of its complete circuit supposed to have at the said point the conductibility, a; it is by the definition the differential of the *instantaneous* value of the quantity of electricity which traverses *normally* in each unit of time the element, $d\,\text{s}$, of the surface of the level passing by the given point.

III. It is important to remark that the foregoing definition implies the following notable hypothesis:

(*d.*) *Each of the elementary electric masses constituting the flux moves always in the same direction as the corresponding electromotive force.*

But this hypothesis requires, according to the laws of mechanics, that the ponderable matter of the conductor exerts upon the current such a resistance that on suppressing the action of the battery each elementary mass of the flux is arrested, notwithstanding its extreme velocity at the end of a space which vanishes in proportion to the smallest of the radii of the curve of the trajectory described by the mass considered.

Such a deduction is acceptable, since experiment shows that in the long run the currents modify the aggregation of the matter of conductors, and further that they heat it, *i.e.*, they augment its vibratory *vis viva* when they traverse it without passing entirely on the outside. But such effects indicate a relatively considerable action between the electric flux and the matter in question. We shall see (VI.), that this action is overlooked, or at least considered in a very incorrect manner in calculating the energy of the currents.

IV. First of all we shall examine various consequences of the equation (1) on the supposition, which has hitherto remained permissible of the respective constance of the flux at each point of the circuit.

By a like conjecture it is proved that the electric fluid possesses everywhere in the interior of the conductor the normal density which constitutes the neutral state as regards the substance of the conductor. This conclusion can be reconciled with the hypothesis of two electricities; for it is sufficient to consider the two fluids as being the same in quantity in every element, and as moving in two equal and opposite currents. In the hypothesis of a single fluid, the most probable at present, the consideration with which we are engaged compels us to admit that the normal quantity of electricity always contained in each element of the volume of the conductor undergoes incessant compositions and recompositions analogous to those indicated by the law of Grotthuss. This necessity, be it said in passing, is not indicated in any text-book. It seems, as if understood, more or less implicitly, that the fluid in movement is fluid in the neutral state; but this cannot be, since the *electric mass* of every portion of a like fluid is null, and, conseqently, cannot experience the action of the electromotive force.

The conclusion above given has the further consequence that the electric masses which give rise to the potential should at most affect the *surface* of the conductor. It is, therefore, necessary that these masses should be distributed in the insulating matter or in the stratum of air which covers this surface. Yet a review of all the experiments of a nature to confirm the fact leads to results which prove little or nothing; we have here, therefore, a first contradiction.

V. The supposition of the constancy of the circuit at every point of the circuit involves, according to equation (1), the condition—

$$(2) \qquad \frac{d\,\text{v}}{d\,a} = \textit{a constant proper at each point.}$$

But v, being also a function of the co-ordinates of the electric masses in action, this relation requires either that there must be immobility in these masses, notwithstanding the reaction which they necessarily undergo from the flux, or that there are produced determinate compensations in their displacements. But both these corollaries being inadmissible, we have here a second contradiction.

To the above-mentioned hypothesis of the *constancy* of the current we may now join that of a conductor, homogeneous or not, but of an elongated form and of very small sections in proportion to its length, and add the supposition of a complete insulation of this conductor, hindering all external loss of electricity. It is admitted as rational (although far from being evident) that the flux moves normally to right sections of the conductor, and that consequently these sections become surfaces of the level. In a like case, if we add to the various preceding conditions that of an equal intensity of the current in its entire circuit, the equations (1) and (2) lead to the well-known formula—

$$(3) \qquad i = \frac{e}{r}.$$

e here stands for the *total electromotive force* of that part of the circuit considered. Its most general expression is—

$$-\Sigma\int\frac{d\,\text{v}}{d\,n}\,d\,n,$$

and belongs not merely to the case of a heterogeneous conductor but to the case where there occur sudden falls of the potention in various parts of the said portion.

r is the *resistance* of this portion, and its value may be represented by—

$$\Sigma\int\frac{d\,n}{a \times \bar{\text{s}}}.$$

With the former definitions the formula (3) is in strictness logically applicable to the complete circuit of a battery formed of voltaic elements, the ends of which are connected by a long wire. But it is not the same for batteries with liquids, and it is only by empiricism that we employ the formula in question, and not as a permissible consequence of the law of Ohm. The fraction of r belonging to the interior of the battery ceases then to have a definite meaning, as also the electromotive force concerning this interior. In short, the study of this same force obliges us to have recourse to the experimental law of Joule, and is consequently affected with the errors in principle which we are about to find in the *a posteriori* demonstration of that law.

VI. For this demonstration we set out from the elementary work, $d^2\,\text{w}$ produced in the time, dt, by forces acting upon each element, dq, of the electric mass of the current, and we write—

$$(4) \qquad d^2\,\text{w} = -\,d\,q\left(\frac{d\,\text{v}}{d\,n}\right)d\,n = -\,d\,q\,d\,\text{v}.$$

We find here a repetition of the second contradiction specified in section V., for if we put

$$\left(\frac{d\,\text{v}}{\text{D}\,n}\right)d\,n = d\,\text{v},$$

we admit that the co-ordinates of the acting electric masses remain immovable.

A more important objection arises. Let us refer to the deduction of the hypothesis (a) section III. According to this deduction the equation (4) should include, besides the work derived from the electromotive force, also the work due to the actions of the ponderable matter upon the electric masses of the current. It will perhaps be replied to our objection that account of these actions has been taken in the term r of the intensity $i = \frac{e}{r}$ of the current, an intensity which is made use of in passing from the said equation to Joule's formula, $\text{w} = i\,e\,t$. But the term becomes in the manner an absolutely empirical co-efficient destined to rectify too late the relation in question, and to make the defects of theory square with the results of experi- [illegible] *Comptes Rendus.* [illegible] trans-

LEWIS'S PATENT SELF-BINDING INSULATOR.

THE object of this invention, which is shown by the figure, is to dispense with the usual binding wire. The binding is effected by hooking on the line an iron clip of horseshoe shape, and then inserting the coarse conical screw, which is cut on the end of the insulator, between the said clip and line-wire. On giving the insulator a turn and a quarter it becomes rigidly fixed in its position, and all chafing and friction is entirely overcome and cut or broken wires are prevented from "running back." If, in some districts, it is considered desirable, the clip may be dispensed with and the binding effected with No. 8 wire. It may also be soldered fast to the line, and yet, notwithstanding this, the insulator may be detached and re-attached instantly without in any way disturbing the binder. The porcelain is kept clean and free from the usual coating of rust, not only by reason of the iron clip which encircles the insulator being galvanised after it is bent to shape, but in consequence of the total absence of friction and "working" of the wires.

Owing to the fact that the clip for gripping the wire touches the insulator at but three points only, it seems probable that a line fitted with the new invention would test better than in the case where the ordinary binding wire, which closely encircles the porcelain, is used. Mr. Lewis's binder is the best we have yet seen, and the advantages which it possesses are so obvious that they need not be enumerated. The general principle of the idea is certainly highly ingenious, and of its efficiency there can be, we think, no doubt. The important item of cost, however, must not be overlooked, and when we consider that the present system of binding costs but ½d. per insulator, and that, although not perfect, it cannot be said to be inefficient, it is clear that the margin of profit which could be made from any substitute would be very small. It must not be forgotten, however, that cost is not the only point to be considered.

ON THE DIFFERENTIAL GALVANOMETER.—By A. Stepanoff.—In order to compare two resistances by means of a differential galvanometer the two series of coils of which are not quite equal, the current is divided as usual between them; in one branch the resistance r is intercalated and again removed; in the other is a rheostat, always so arranged that no deviation is perceived on closing the circuit. Let n_0, n_1, n_2 be the graduations of the rheostat which answer to this requirement for $r = 0$, $r = r_1$, $r = r_2$, then,

$$\frac{r_1}{r_2} = \frac{n_1 - n_0}{n_2 - n_0}.$$

Wiedemann's Beiblätter.

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TO CORRESPONDENTS.

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CORRESPONDENCE.

UNITED STATES PATENTS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In the articles which appeared in your journal in April last on "The Law and Practice relating to Letters Patent for Inventions," I adverted to the fact that the lapse of a patent taken in one country or colony frequently limits the duration of patents posterior in date, obtained in other countries or colonies for the same invention, and I suggested means, the adoption of which was calculated to secure to patentees the maximum duration practicable for all their patents.

The subject is one which will well repay careful study, and I may probably, with your permission, on a future occasion consider it in all its aspects and phases, but my present object in addressing you is to direct attention to an anomaly in the patent law of the United States (or, rather, in the administration of the said law) which will, I think, surprise those of your readers who have been accustomed to look upon America as *the* country *par excellence* distinguished for liberality to inventors.

The point to which I allude is this: It appears from a decision which has been given by one of the judges in a case brought before him involving the question of the validity of a United States patent, that where a foreign patent—as, for example, a Canadian patent—granted prior to the issue of a United States patent for the same invention is taken for a short term only in the first instance, *although extended* subsequently to the issue of the United States patent, the last-mentioned patent will lapse at the expiration of the term for which the Canadian or other anterior patent was *originally* obtained.

Although in the case to which I refer the particular prior patent which curtailed the duration of the United States patent was a Canadian patent, yet an Austrian, Italian, or Portuguese patent would obviously have the like effect under similar circumstances.

That this decision is not only illogical, but egregiously absurd, will be made apparent by assuming the case of a French patent and an Austrian patent, both taken previously to the issue of a United States patent.

The French patent is granted for, say fifteen years, but its maintenance is contingent upon the payment of an annual tax. The Austrian patent is taken for, say, one year (in order to obviate the necessity for paying up the whole of

the taxes in advance), and then prolonged annually until the maximum of fifteen years is attained. Now what difference is there between the fifteen years' French patent, kept up by an annuity, and the Austrian patent annually renewed? Each requires a yearly payment to be made in order to maintain the protection, and both would alike lapse or expire in default of such payments. Yet the law (according to the learned judge's ruling) draws a distinction where there is no real difference, and says, in effect, that the United States patent must be held to expire at the end of one year from the date of the Austrian patent, even although the whole of the payments required to maintain the Austrian patent in force are punctually made, simply because the patent *in terms* was originally granted for one year only.

I can scarcely believe that this ruling will be supported, entailing, as it does, the invalidity of nearly all the United States patents obtained for inventions imported from other countries; but there it is, and the condition of things is by no means satisfactory to patentees.

The climax of absurdity, however, has even yet not been reached. Some legal authorities in the States have given it as their opinion that the lapse of the French patent through non-payment of one of the annuities, or for default in working the invention, would *not* involve the forfeiture of the United States patent simply *because the French patent was originally granted for fifteen years!* This is "confusion worse confounded," and I fear will cause your lay readers to abandon in hopeless despair the task of attempting to master the subtleties of patent law and practice.

I may add that I, for one, do not endorse the opinion of these legal authorities, as I think the language of the statue is perfectly clear on this point, but I would advise inventors pending the determination of the other part of the question by the Supreme Tribunal or by fresh legislation, to apply for their United States patents as well as their French and German patents as soon as possible after obtaining provisional protection in Great Britain, and then, should the issue of the United States patents be unduly delayed, to secure any other foreign patents they may wish to obtain, for the longest terms possible, even although this course will necessitate a larger cash outlay at the commencement.

I am, dear Sirs, yours faithfully,
THOS. J. HANDFORD.

Southampton Buildings, *November 4th.*

SECONDARY BATTERIES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I notice that much of your space is becoming occupied by correspondence with regard to secondary batteries. May I, as a layman viewing the matter purely from the commercial stand-point, venture to ask some of the advocates of accumulators to tell us the advantages in pounds, shillings, and pence, which we may look for by the adoption of these as additions to the electric system of lighting?

As far as I can as yet see there must be an addition of at least 20 per cent. to the coal bill, as there is that amount of loss in the cells; there must be a heavy charge—I should say about 35 per cent. per annum—for the depreciation of the cells in use, and there must be a good deal of additional skilled labour employed in keeping the cells in order in the various places where they are lodged.

Against these charges it is, I believe, claimed that a much smaller expenditure of capital is necessary for dynamos and engines, as one machine working 24 hours can accomplish as much as 4 machines working 6 hours, the actual period of lighting. This I find, however, is counter-balanced by the cost of accumulators in use with a suitable reserve. Indeed, I find that a complete duplicate set of machinery can be kept in readiness at a less initial cost, and at a much less annual working expense.

If the functions of the accumulator in electric lighting are to be limited to regulating the current, it seems to me it will be a very costly regulator.

I do not doubt that there are *some* circumstances in which the accumulator may prove helpful, but we hear it spoken of as the one essential to incandescent lighting hitherto lacking, the gasometer of electricity, &c., and I should like very much to see how the additional cost is to be got over.

Your obedient servant,
ACCOUNTANT.

[illegible]*ber 4th,* 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Referring to the notice of Mr. F. W. Cooke (page 353 of your valuable journal), I should like to mention that Dr. Boettcher of Leipzig exhibited at the Munich Exhibition some secondary batteries, in which also a zinc plate is used, instead of the other lead plate.

Dr. Boettcher took out some patents for his invention. I hope to be able in a few weeks to give an account of the measurements to be made with this battery.

I am, Sirs,
Yours obediently,
F. UPPENBORN.

Nürnberg, *November 6th,* 1882.

ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—We are, I am afraid, about to enter on serious and depressing times for electric light securities. It is doubtless natural that after much unnecessary and rampant speculation in shares, that never possessed any real value, a time of dulness and inactivity should supervene.

The investing public will now, however, have to study the question, and if (and it would be wise) electric light shares were purchased as a hedge to gas stock, the question arises as to which of the companies now providing the new illuminant are sound, possessing at the same time patents for systems likely to stand the test of time.

I consider we have three systems now before us—regulator lamps, electric candle, and incandescent globes. The first are numerous, with but a shade of difference between them: a pole in one system moving up, in another down, but all having mechanism to regulate their actions. Now a lamp, to stand all weathers and every conceivable situation, had better dispense with mechanical contrivances, save in special cases, such as lighthouses and the large lights for men-of-war, where, in both instances, constant attendance is *always* at hand.

I now come to the Candle, that is to say, Jablochkoff. which is simplicity itself. Without it we should not have been where we now are in electric lighting, and the reason why so many systems of regulator lamps exist is clearly because the above-named candle, being so very simple, defies imitation, without infringement. I by no means consider the Candle perfect, or removed from the sphere of improvement. Better carbons, another type of engine (steam or gas), will ere long rectify what is wanted, and the simple electric taper, burning quietly, like its more ancient sisters of tallow, wax, or stearine notoriety, but with a different brilliancy, must, I think, eventually be the system of lighting for general use.

Incandescent. To those who carefully consider this system, be it Swan-like, Fox-like, of Rogers' type, or as Edison, Maxim, or many others have it, it must be clear all are the same, and I agree with *Truth,* little patent exists in any, or all, of them.

The times we live in require *more* light, *not* an exhibition like Holborn Viaduct, where the illumination is inferior to gas and no better as to the colours given by it; a pretty little toy, but a very expensive one, requiring a horse-power for seven of the little globelets, amounting in all to 80 candles of light, whereas one horse-power would, in arc lighting, yield from 1,200 to 1,400 candles of illumination.

Electric science proceeds with giant strides, but until incandescent lamps can be made to burn at distances, many, many times further removed from a "centre" than they can now, save at enormous cost for "conductors," the bijou light can never be for any, save *well-to-do folk,* who may for a time, for its novelty, like it; but when the useful turning up and down of gas in chambers or sick rooms [illegible] to be desired, the "toy" will be given up. It doubtl[illegible] is [illegible], but it is much more expensive than the [illegible] faithful servant who has held sway for now nearly [illegible] century. The only place I think incandescent lamps are [illegible] in their place is on board ship, for lighting the cabins, an[illegible] where saloon, between-decks, and engine-rooms are ligh[illegible] by arc, the small lamps would doubtless be most useful [illegible] and if worked by a system that on some wires can carry [illegible] arc and incandescent, it would be obtainable at a reasonable [illegible]

I have given a hurried sketch of the positi[illegible] I think we

are at present in. Your readers must think and judge for themselves, asking, however, this: Is there in regulator lamps a patent that can hold water, and is there an incandescent one that possesses a patent at all?

I was offered a new lamp of this type lately, price 10d., a considerable drop from the present prices asked for incandescent lamps, which are *now* considered to possess some value.

Yours obediently,

ELECTRON.

London, *November 6th.*

[We cannot agree with our correspondent regarding the lighting of the Holborn Viaduct. It is better than at its commencement, one lamp of moderate candle-power being now used in place of two indifferent ones formerly employed. The result appears to us not inferior to gas but slightly superior. "Electron" is also at fault in his estimate of the candle-power per horse-power given by incandescence lamps, which is considerably higher than the figure he quotes, and which of course increases greatly as the current passing through each lamp is augmented. We have not lost faith in a successful future for the Jablochkoff system, but the cost of carbons in arc lighting must not be overlooked, and we refer "Electron" to a short article in our present issue from another correspondent on a combined system of "arc" and "incandescence" electric lighting.—EDS. ELEC. REV.]

MEANS FOR OBTAINING THE ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In answer to "Natalian" in your number for September 16th, you say that "the only cheap, convenient, and practical way of obtaining sufficiently powerful currents for electric lighting, is by the employment of dynamo-electric machines."

The Duplex Electric Light, Power and Storage Company have what they call in their prospectus, a "Battery system by which the use of engines and dynamos is obviated."

A description of this system, which "has been tried very successfully at the Comedy Theatre," would be interesting, unless it is the same as that employed in lighting the Comptoir d'Escompte already described in your valuable Journal.

Yours faithfully,

H. P. K.

ELECTRIC TRICYCLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your correspondent, "Chancery Lane," may well ask "What is the use of an Electric Tricycle?" if in this fast age one is to be compelled to travel at the ignominious rate of four miles per hour and have an *avant coureur* with a red flag to announce our coming to Hodge and his cart-horses.

Of course we all know that the Act of Parliament was aimed at traction engines, steam rollers, and such like noisy but useful monstrosities, and not at the useful and natty tricycle or any other form of velocipede driven by electricity. The Court of Queen's Bench, however, in their wisdom have decided that tricycles driven by other than animal power do come within the meaning of the Act, and that any person using one except in compliance with the provisions thereof is liable to a penalty not exceeding ten pounds.

Now I take a great interest in electric tricycles, and I quite agree with Mr. Reckenzaun that the subject of locomotion by electric energy is of immense interest to all classes, and being so impressed, I, in my blissful ignorance of the law, set to work to build one, when all at once to my horror and consternation (and I have no doubt to that of many other similar workers in the same cause) came the decision in Parkyns *v.* Priest. My friends consoled me with the belief that the case would be appealed, and the decision upset. For confirmation of this view I had an interview with my lawyer, but all I got from him was a shake of the head. I frantically endeavoured to impress upon his legal mind the difference between a traction engine and a tricycle, but he refused to be convinced, and pointed grimly to the words of the Act, "other than animal power." These words seemed to haunt me like Banquo's Ghost, and I began to consider their insertion in the Act as a kind of personal injury, until, one day, a happy thought struck me, which ultimately developed into a practical idea; this I embodied in a specification and submitted it to my grim lawyer, who returned it to me with a grin, and an expression of opinion that an electric tricycle built upon my improved plan would not be an infringement of the Act, but with the natural caution of his class, advised a conference with counsel. A counsel, well-known and respected by most inventors, was thereupon consulted, and my lawyer's opinion fully confirmed. A specification has in consequence been duly filed, and in due course will be made public.

I have only mentioned the above trifling facts for the benefit of our legal friend "Chancery Lane," who, doubtless, has been having a good chuckle over the electricians and their tricycles; but for the information of others I may state that the principle of the invention is the use of electricity as a simple auxiliary, thus reducing the "animal power" required for propulsion to a minimum, but so arranging the machine that without such "animal power" (however small) being exerted continuously the tricycle remains motionless.

I hope to have a machine made on the above principle completed in time for the approaching exhibition, I shall then have great pleasure in sending you full particulars, with diagrams, weight, &c., if you consider the matter of sufficient interest to your readers.

Yours, &c.,

JNO. MACDONALD, C.E.

7th November, 1882.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Your correspondent, A. Reckenzaun, C.E., is, we presume, a draughtsman who was in our employ for a few weeks, and who, after endeavouring to carry out some of our then unpatented designs, left us rather suddenly. We quite sympathise with the curiosity he evinces as to the way in which our ideas have been carried out, but we fear that our willingness to give the public this information is not particularly increased by the fact that it is he who asks for it. As, however, the electro-motor used for driving the tricycle has been already patented in several countries, and will soon be patented throughout the whole world, Mr. A. Reckenzaun, C.E., will shortly have ample opportunity of reading a full description either in English or in his own language.

We are, very truly yours,

AYRTON AND PERRY,

Engineers to the Faure Electric Accumulator Company.

[We have no knowledge of Mr. Reckenzaun beyond his association with the Electrical Power Storage Company, as the company's mechanical engineer. Perhaps Mr. Reckenzaun can find a suitable reply to the but half-concealed imputations of Professors Ayrton and Perry.—EDS. ELEC. REV.]

OFFICIAL REGISTRATION.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I would like to know why the official return of the Edison Electric Light Company has not yet been filed at the office of the Registrar of Joint-Stock Companies. According to the Companies Act such return should be made within four months of registration, but the Edison Company has certainly been incorporated a much longer period.

INQUIRER.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY'S FLEET OF CABLE STEAMERS.—The s.s. *Seine* arrived on Monday, the 6th inst., in the river Thames, on her return from duplicating the Lisbon-Madeira cable for the Brazilian Submarine Telegraph Company. The s.s. *Kangaroo* has completed the laying of the Malta-Tripolis cable, and, as we understand, is now in Egyptian waters. The s.s. *Calabria*, lately employed as a Government transport to Egypt, and the s.s. *Scotia*, since her return from repairing the Atlantic cables, are now in the Victoria Docks.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

THE MUTUAL UNION TELEGRAPH COMPANY.—We observe in the New York *Herald* of October 3rd that the above company, as yet one remaining unabsorbed by the Western Union Company, "was projected in 1881, and it first began to transmit messages on the 1st of January, 1882. The company has been engaged for about a year and a half in building lines, and has now about sixty thousand miles of wire. It extends from Bangor, Me., in the north-east, to Kansas City, in the south-west, passing through Louisville, Cincinnati, and St. Louis; from Ottawa, Canada, through Toronto and Montreal, along the southern shores of the great lakes, through Buffalo, Cleveland, Detroit, Chicago, Milwaukee, St. Paul and Minneapolis, its north-western terminus nominally, although Madison, Dakota, a small town a good deal beyond that, is the real *ultima thule* for the present. A second main line connects Chicago with Washington through Pittsburg. The construction is still being pushed rapidly forward most vigorously beyond Kansas City in the direction of St. Joseph, Denver and Salt Lake being also in view. The company will eventually have a network that will embrace all the important cities of the continent. Its immediate object, however, is to include only those in its circuits which are valves, as it were, in the main arteries of trade. It has avoided thus far the building of short and minor lines, the business from which might clog the transmission of more important messages from one commercial centre to another. The paid capital of the company, according to its officers, represents actual poles and wires and the cost of erecting them, not fictitious values on which a large interest must be exacted from the public. It is bonded only to the extent of 5,000,000 dols., and beyond the interest on that amount it has no fixed charges."

INDIA-RUBBER AND INSULATION.—We learn from an American source that rubber manufacturers are now much concerned, because speculators hold absolute control of the entire production of South America, and fix the prices of the raw material to suit themselves. In 1879 the raw india-rubber, or caoutchouc, was worth but 75 cents per pound. At that point the speculators seized upon it, and, as a test of their temporary strength, put the price up to 1 dollar per pound. Under that pressure a quantity was dragged into the market through channels over which they had not yet obtained control, and the price dropped to 80 cents in the spring of 1880. It has never since, however, got so low, for the speculators developed strength enough to cover the entire ground, and have made prices what they pleased. Just now they are higher than ever before, viz., from 1 dol. 17 cents per pound to 1 dol. 23 cents. Buyers were refused prices by holders, on the pretext that there is no stock in the market, and that figures cannot be named until the arrival of the next steamer. This, however, is affirmed to be untrue, as it is said some 1,200 cases of rubber came in by the last steamer from Para, and are now being held until such time as the necessities of the manufacturers will compel them to submit to another heavy advance. In this extremity the manufacturers have been spurred to an attempt at concerted action to protect themselves, and have called a meeting to devise measures for neutralising in the future the power of the present speculators. To meet this condition of affairs, the manufacturers expect to be compelled to form a colony in Brazil, and to establish trading posts of their own. The consideration in all this business is that the higher the price of crude rubber the greater will be the adulterations to which it will be subjected.

THE CROYDON BOARD AND THE ELECTRIC LIGHT.—Mr. Morland brought up the following special report from the General Purposes Committee:—*Electric Lighting Act* 1882.—The committee further considered this subject. Read a letter from the Gülcher Electric Light Company, stating they had no immediate intention to apply for a provisional order, and suggesting the adoption of their system. Read a letter from the Croydon Electric Light Company, with an abstract of the proposed provisions empowering them to supply electricity for private and public purposes within the boundaries of the parish of Croydon, be inserted in the licence which they ask the board to grant, and stating that in the event of the board not consenting to a licence, so that the company have to apply for a provisional order, the company will not then be bound to insert all the provisions, but will feel at liberty to obtain the best terms they can for themselves. The clerk submitted a statement of the course which has to be adopted by the board in the event of their applying for a licence or a provisional order. The committee recommend the board to consider on Tuesday whether they will themselves undertake the supply of electricity. In moving the adoption of this report, Mr. Morland said that the question really was, whether the board were prepared to take the lighting of the town by electricity into their own hands, or whether they were prepared to give their sanction to any of the companies who proposed to light the town. No doubt the Local Board could supply it cheaper than any company, because they had land at their disposal and could borrow money on better terms. Moreover, it was highly important that the board should have exclusive control over the roads for the purpose of laying pipes. Croydon was not particularly well adapted for being lighted by electricity, and doubtless there would be a loss for the first year or two. Personally he was in favour of making arrangements with one of the companies which had applied, and allowing them to obtain a licence for seven years. After that time the board could, if they thought fit, take the matter into their own hands. Mr. Rymer thought that Mr. Morland's views were hardly those of the committee. For his own part he was in favour of matters being kept in the hands of the board rather than allowing some foreign body to come in. Mr. Layton said the board wanted more information before they could decide on such an important matter. There were many points to be considered in connection with the matter, such as the establishment of subways and other details, and he did not think they were prepared to decide at once. Mr. Mitchiner moved that the board apply for a licence. They need not use it, but then possession would enable them to obtain better terms from the companies. Mr. Elborough asked if it were possible to obtain a licence and not use it, thus blocking the way? The Clerk quoted a clause from the Act to the effect that it was not. Mr. Coldwells moved the adjournment of the debate and expressed his opinion that a good many electric lighting companies would soon be crushed by the action of the Lane-Fox people. Finally Mr. Rymer, on the advice of the clerk, withdrew his motion and gave notice, in accordance with the provisions of the Act, that he would bring it on that day six weeks. The report was then adopted.

ELECTRIC LIGHTING.—The Todmorden civil authorities have decided to apply for a provisional order.

THE Brush Electric Light and Power Company (Scotland) has made arrangements with the Dundee Police Commissioners to light Commercial Street.

THE Ripon City Council, at their last meeting, adopted the following recommendations submitted by their Electric Lighting Committee:—(*a*) That this Committee after consideration of the capital invested in the gasworks, which on the 25th March last amounted to £17,235 10s., of which only £4,190 10s. is paid off, and being of opinion that the city is at present very well lighted by public lamps, recommend that the applications made by four electric lighting companies for provisional orders to supply electricity to this city be opposed by the council. (*b*) That this committee cannot recommend the council to apply for a provisional order under the Electric Lighting Act 1882, on account of the cost that would be incurred thereby; and for that reason the committee consider it inexpedient to introduce the electric light into the city.

Professor Niven, in opening the Winter Session of the Aberdeen Natural Philosophy Class, incidently referred to the great strides the science of electricity had made. Long confined within the walls of the laboratory electricity had now become an important factor in our daily life, and had entered the field as a producer of light. It was too early to speak of its future in this respect, but there was no doubt that if the electric light could be produced as cheaply as other kinds, its struggle for supremacy will not last long.

The Dundee Gas Commissioners assembled last week to consider a report prepared for them by the manager of their gas works as to the introduction, cost, &c., of the electric light.

In the course of the discussion on the report, one gentleman remarked that the Northern Electric Light and Power Appliances Companies deserved great credit for the highly successful experiments at the Fine Art Exhibition. The cost was the same as that charged for gas during the corresponding period of last year. Another gentleman pointed out that it would be a serious matter if personal responsibility were attached to the Commissioners in connection with the supply of electric light, and proposed that a report as to their application should be asked from their legal adviser. This was agreed to.

The Anglo-Austrian Bank is planning the institution of a company to introduce electric light on a large scale in Vienna. The National Bank has undertaken to make the same arrangement for Berlin. The company would commence with a capital of 4,000,000 marks in Berlin, and 3,000,000 florins in Vienna. The system to be adopted would be Edison's.

The Town Council of Aberdeen, on Monday, decided to apply to the Board of Trade for a Provisional Order. They also voted the sum of £500 for experimental electric lighting.

The Harrogate Town Councillors, on the report of their solicitor, have decided to obtain a licence for supplying electricity.

The Glasgow Corporation have refused the application of the Scottish Brush Company to light an area of Glasgow; but, anxious to keep in the front, are prepared to consider any specific offer for lighting the streets by electricity, which the company may put before them, whereby the authorities will be relieved of all expense in connection therewith.

The Hanley Town Council are to meet specially on the 24th instant, to consider the several notifications sent them by electric lighting companies.

The West Bromwich Gas Committee report to their Council that as the electric light is still within the domain of experiment, and its introduction by the committee would probably involve a heavy outlay, accompanied by great risk and responsibility, they prefer to wait until more definite information can be obtained. It was resolved by the council to oppose all applications by electric lighting companies for Provisional Orders. There is no desire, however, to keep out the companies, provided satisfactory terms can be arranged.

The Walsall authorities are not to apply for a licence or Provisional Order, they being of opinion that the outlay would be great and entirely speculative. They will watch the procedure of the electric lighting companies who apply for Provisional Orders and support any one, if it is desirable to do so, or oppose all of them.

The Glasgow Head Post-office is about to be lighted throughout by electricity.

The Fenton and Kidsgrove Local Boards have agreed to take no active steps at present as to the supply of electricity within their boroughs.

At the meeting of the West Hartlepool Improvement Commissioners on Tuesday last a letter from the Gülcher Electric Lighting Company was read, stating that for the present they did not propose asking for a Provisional Order affecting West Hartlepool, and expressing their satisfaction that the Commissioners are themselves taking steps in that direction, and the hope that in the event of the adoption of the electric light the Gülcher may be selected.

The Aberdeen Market Company invited their renters and the public to visit the shop of Mr. Duncan, Union Street, on Tuesday evening, for the purpose of viewing an exhibition of flesh, fish, and other marketable products under the electric light. [We are glad to see that the local press is giving to the electric light the attention it deserves and encouraging its extension.—Eds. Elec. Rev.]

The Stranraer Town Council have decided not to apply for a Provisional Order. The decision has given rise to a good deal of feeling. One of the councillors, writing to the press, gives three reasons why the electric light should be introduced :—"1st, the price charged for gas is too high; 2nd, the unjust and iniquitous rent charged for the meters; 3rd, that electricity should be placed in competition with gas whenever that can be done with profit, and this, I say without fear of contradiction, can be done in Stranraer."

Maxim-Weston Electric Light and Power Company.—We understand that this company has concluded an advantageous contract for the sale of their patent rights for the whole of the Australian colonies, New Zealand, and Tasmania.

The Way to Discredit the Electric Light.—"Now that the electricity mania has subsided," says the *Economist*, "and proprietors are counting the cost, it is but natural to hear the shareholders in the off-shoot Brush companies angrily complaining of the large sums netted by the parent concern. Nothing so tends to discredit a system as a string of prices such as those below :—

	Paid-up.	Market Price.
Australasian Brush	3	$1\frac{3}{8}$ dis.
Brush Midland	$1\frac{1}{2}$	$\frac{1}{4}$ dis.
Brush of Scotland...	$2\frac{1}{2}$	$1\frac{1}{4}$ dis.
Eastern Brush	4	$1\frac{1}{2}$ dis.
Great Western Brush	$2\frac{1}{2}$	$1\frac{1}{2}$ dis.
Metropolitan Brush	3	$2\frac{1}{4}$ dis.
South-Eastern Brush	$1\frac{1}{2}$	1 dis.

"There are other off-shoots of the Brush Company respecting which no prices are recorded. The public are only too ready to jump to the conclusion that a system of lighting which is thus valued by the Stock Exchange must be a faulty system; and where, as at the present day, the merits of so many of the different lights stand nearly on a par one with another, it makes a considerable difference how the Stock Exchange gauges those relative merits. That advantage was taken by the parent company of the recent mania to realise a large sum there can be no doubt, and the result is that an amount of capital has been embarked in the venture which it is, as yet at any rate, quite unable to bear. The plan of cramming a host of subsidiary concerns upon the public has been tried on many previous occasions, and has always ended in sacrificing the property for the immediate gain of the vendors. The electric light is quietly moving in different directions; but to invest an excessive amount of capital in a novelty of any kind serves rather to check than to advance its merits with the public. Whether the meeting of the subsidiary companies' directors will be productive of much good is doubtful, for it does not appear very probable that they could recover, even upon the ground of misrepresentations in the prospectuses. Meanwhile the threatened litigation tends still further to shake public confidence."

The "Subsidiary" Electric Light Companies.—The *Bullionist* hears that after much discussion the representatives of the various subsidiary Brush light companies who assembled at the Cannon Street Hotel last week resolved to seek counsel's advice as to what the actual position of the subsidiaries with reference to the "exclusive" or "entire" rights of the Lane-Fox patents which they supposed they had purchased from the Brush and the Hammond Companies. The Hammond Company, it is added, distinctly repudiate any liability, on the ground that whatever concessions they sold were drawn up word for word as they were purchased by them from the parent company. In any case, the matter is in *statu quo*, and the subsidiary companies are farther off work than they were when first instituted. Counsel's opinion will be awaited with much interest. In seven of the subsidiaries, viz., the Australasian, Metropolitan, Eastern, Great Western, Midland Scottish, and South Eastern, the consideration money is more than half-a-million. As the Brush have already parted with most of this in their famous dividend of 100 per cent., the outlook for them, if an adverse opinion is

given, is not very encouraging. Without reckoning the large premiums which the public have in many cases paid for their shares, there is a sum of about eleven or twelve millions locked up in electric lighting undertakings and practically unrealisable even at a discount of 50 per cent.

ELECTRIC LIGHTING AND LAW SUITS.—The *Pall Mall Gazette* says that the fighting amongst the electric lighting companies is about to begin in earnest. Individual shareholders in the companies created for the purpose of buying "patent rights" for this or that so-called patent company, have already begun to issue writs with a view to obtain the refunding of their money, and it is now stated that the directors of a number of the subsidiary companies are about to take combined action for the same purpose. This will surprise no one familiar with the extraordinary proceedings attendant upon the creation of these companies, and it is possible that the experiences consequent upon a thoroughly good fight in the law courts may do much to check similar abuses in the future. That, however, is a doubtful point, and after all it is not possible to feel any deep concern for those who allowed themselves to be taken in. Few of them believed the statements of the prospectuses issued. A few, of course, did get caught up in the wave of mock enthusiasm about electric light, and for their sakes as well as for the wholesomeness of the lesson we hope the schemers will be made to disgorge, but there is not much room, on the whole, for moralising over the fate of one set of rogues more than another.

THE ELECTRIC LIGHT IN THEATRES.—We read in the *Standard* of the 7th inst. that much disappointment was created by an accident at Brünn during the preceding evening, where a new theatre was to have been opened, illuminated with the electric incandescent light. It was found that the lead connected with the conducting wires had mostly been melted by the current.

THE FAURE ELECTRIC ACCUMULATOR COMPANY.—The shareholders of this company had a meeting last Monday, the report of which appears in the present issue of the ELECTRICAL REVIEW. We commend it to the attention of our readers, as it contains much that is interesting, as showing the disposition of those who can influence the company to follow the lead of a patent-vending company, which *hitherto*—we write hitherto advisedly—has seemed very successful. It also contains the elements of humour; for instance, M. Philippart, in his address, which was read to the meeting, said: "But in order to facilitate payment in advance, La Société la Force et la Lumière offers to give you one £10 fully-paid share in exchange for two of your shares with £2 paid, which you hold in the Faure Accumulator Company." Can anything be kinder? £10 going for £4, who will buy? Of course £10 printed on paper does not always mean £10 sterling, but it only needs the association of M. Philippart's name with the scheme to make one feel sure that something very disinterested is lurking behind the offer. In one portion of the speech M. Philippart said that in order to obtain success, in compelling the company to the course of patent-splitting and vending, he and his friends "had recourse to an irresistible argument." They became proprietors of three-fourths of the ordinary shares of the company, being already holders of all the deferred shares. We confess to feeling a slight tinge of regret that they did not become proprietors of all the shares, and concur heartily with our contemporary, the *Pall Mall Gazette*, which says that "Decidedly more light is required about this curious transaction." That inventors will not let the subject of accumulators remain in its present position is certain, and therefore it would appear advisable that the Faure Company (or indeed, any company), should get to work with legitimate business, rather than waste its opportunities in forming and re-forming itself, while other and better storers of electricity may be advancing to render the existing patents comparatively valueless.

UNDERGROUND CABLES.—The *Chicago Tribune* says:—The Western Indiana Railroad Company is laying a new underground telegraph cable from the Archer Avenue Station to its offices on Washington Street. About a year ago the company put down a cable whose peculiarity was the enclosing of the wires in glass tubes and the filling of the interstices with hot resin. It, however, did not work, the glass breaking in turning a curve, and the resin crumbling. So it was abandoned. The present cable is the invention of Mr. William R. Patterson, Superintendent of the Cable Department of the Western Electric Company of this city. It consists of copper wires, covered with cotton and jute thoroughly dried, which are pulled through a lead pipe. The space between the wires and the pipe is filled with melted paraffine oil, charged with carbonic gas. The presence of the bubbles of gas throughout the paraffine prevents shrinking or cracking when the paraffine cools, and in case of injury to the pipe water cannot reach the wires or damage any considerable length of the cable. It is made in lengths of 500 ft., or more if required, the length depending altogether upon convenience in handling. That now being put down contains twenty wires, which are enclosed in a lead pipe an inch and an eighth in diameter. The sections are joined by slipping sleeves on the ends and screwing in a T, in which the wires are spliced, a "bell" covering the place. By digging down and unscrewing the "bell," a test can be made at the junction. But regular test-stations are put in at different points.

The Western Electric Company has been making these cables for over a year past, and the largest one—5,000 ft.—is in successful operation in a tunnel on the Lehigh Valley Road, near Phillipsburg, N.J. One has been sent to Australia and another to London.

A test has recently been made of the Patterson underground cable in the presence of Prof. Barrett, Superintendent of the fire alarm service; Mr. Sala, Superintendent of the railroad company's telegraph lines; Mr. L. G. Lang, Superintendent of the Union Signal Company; Mr. Kellogg, of the Western Electric Company; George B. Swift, of the American Cable Company, and a number of other interested persons. The inventor and Mr. Kellogg, of the Western Electric, had charge of the experiments. The instruments used were a Sir William Thomson "dead beat" reflecting galvanometer, and a battery of 100 cells for insulation tests, and a standard condenser and a battery of five cells of chloride of silver for the capacity tests. The results were an average insulation resistance of 1,200 megohms, and an electrostatic capacity of about half that of gutta-percha per mile. The conductivity gave 23 ohms to the mile.

"The capacity," said Mr. Patterson, "is from a half to a third that of gutta-percha, and the insulation shown has never been exceeded, except on some of the ocean cables.

ORIENTAL TELEPHONE COMPANY.—A special meeting of the Oriental Telephone Company is convened for the 13th inst., to consider the agreement of the sales of patent-rights to the Bombay Telephone Company, and to consider a proposal to alter the Articles of Association, empowering the directors to effect sales of the business in other countries.

THE TELEPHONE.—From Dundee we hear that telephone intercommunication is gaining ground, and that week by week subscribers are being added to the lists of the two local companies.

AN INNOVATION.—Mr. Howe, the new United States Postmaster-General, contemplates the establishment of a system of postal telegraphs in imitation of the British Post-office.

A DELICATE POINT.—A printer in Philadelphia has brought an action against a telephone company for removing their instrument from his premises on the ground that it was being made the medium of profane and vulgar language. The printer denies the general charge, but admits the use of "damn." The point, therefore, for the Court is: Is damn a profane word? "The decision," says an American contemporary, "will be awaited with deep interest by a host of worthy men, and possibly by 'devout women,' not a few who, in moments of great physical or mental torture, have found a grateful solace in the use of that compact and cogent expletive."

Telegraphic Extension.—The Paraguayan Government has been authorised by its Congress to obtain a loan for the establishment of a telegraph line between Asuncion and the Paso de la Patria. This line will join the Argentine line extended beyond Corrientes, putting the country in telegraphic communication with the rest of the world.

Cable Factory in St. Petersburg.—Messrs. Siemens and Halske, the well-known electricians of Berlin, have recently built a factory at St. Petersburg for the manufacture of cables and other matters connected with electricity. They expect to be able in this factory to prepare some 2,000 miles of submarine cable every year.

Electric Railways—Their Advantages and Disadvantages.—At a recent meeting of the Boston Society of Civil Engineers, Mr. G. W. Blodgett made some observations on the subject of electric railways, which are thus reported in the journal of the Association of Engineering Societies. The disadvantages of the ordinary railway are obvious, such as: 1. The weight of the locomotive and tender is a dead loss, and moved at a great expense, and these carry no useful load. This weight sometimes amounts to 50 per cent. of that of the remainder of the train. It is concentrated on a few points, and entails heavier, stronger, and much more costly bridges and tracks, and much more labour and expense in maintenance. 2. It produces large volumes of smoke and cinders. These and the noise of escaping steam are disagreeable and annoying to passengers and the public in general. 3. Danger to life and property from the explosion of boilers or from fire. 4. The small percentage of useful effect of the coal consumed compared to what might be obtained under a stationary boiler, owing to large surface exposed to radiation, and general unfavourable condition of consumption. Coal is often not completely consumed.

In electric propulsion we have the following advantages: 1. Every pair of wheels can be utilised for motive-power, or in stopping the train. 2. By suitably adapting the speed of the generator to that of the electro-motors, as much as 70 per cent. of useful effect of the generators can be converted into motion. 3. Experience shows that with an electro-motor as high a rate of efficiency as one horse-power may be obtained per 50 lbs. dead weight of motor. 4. By properly arranging the connections a train running into a section already occupied by another train will be brought to an immediate standstill, and will remain at rest until the preceding train has passed out of that section.

Some practical disadvantages in the use of electricity for this purpose are: 1. The large expense of installation. 2. Loss of current by leakage. The prevention of this is by better insulation, but this is at greater expense both in first cost and in maintenance. The leakage can be reduced to not much more than ten per cent., even on long lines, by appropriate means. 3. Danger to life if laid on streets, or indeed on the surface of the ground. Safer for elevated roads than for surface roads. 4. Inconvenience in repairs. These must be carefully made and without interruption of continuity of circuit. 5. A break of a serious nature would bring every train to a stop, none of which could be moved until the repairs were effected.

A brief description of Siemens' railway, exhibited at Berlin, 1879, and London in 1881, was given. In this road the current was led to the train by a third rail or wire laid between the others and returned through the ordinary traffic rails. In the tramway at Paris, the current was conducted to and from the car by two wires overhead, on which ran a small, light carriage attached to the car by wires, and through which the current was conducted to the motor. Brief notice was also made of experiments of Profs. Ayrton and Perry, but fuller description of their proposed ingenious system was postponed to a future meeting.—*The Operator.*

Mr. Edison's Patents.—On the 22nd of August last 18 patents were issued to Mr. Edison by the United States Patent Office; on the 5th September, 1; on the 19th September, 31; on the 3rd October, 1; and on the 10th October, 12; or 63 in all. The total number of patents issued to him up to the 14th October last was 149, in addition to which he had no less than 135 applications lodged for additional patents.

On the Electrolysis of Hydrochloric Acid.—By M. D. Tommasi.—The electrodes of the voltameter being of platinum, two cases may present themselves according to the degree of concentration of the hydrochloric acid. If the acid is strong the positive electrode is attacked by the chlorine, and behaves then like a soluble electrode. If the acid is dilute, there is also a disengagement of chloric products, but the platinum is not attacked. Let us examine successively these cases.

a. Very strong hydrochloric acid. Two molecules of hydrochloric acid in the state of solution absorb, when being decomposed, 78·6 calories; but the positive electrode being attacked by the chlorine, from these 78·6 calories must be deducted the quantity of calories given off by the formation of the dissolved platinum chloride, which tends to reduce the electromotive force of the battery required to effect this electrolysis. The electrolysis of the acid may be produced with an electromotive force much inferior to 78·6 cal. Thus a Daniell element (E = 49 cal.) and a zinc-cadmium element (E = 16·6 cal.) decompose hydrochloric acid briskly, hydrogen being given off at the negative pole, but without production of gas at the positive pole. A single Daniell suffices for decomposing hydrochloric acid, but the electrolysis is then very slow. In order to have more decisive results I have employed a Daniell and a zinc-cadmium element, say, 65·6 cal. After 20 hours the escape of gas still continued at the negative electrode.

The liquid of the voltameter contained a certain quantity of platinum in solution. I have repeated this experiment, employing an electromotive force a little higher than that indicated by theory as sufficient for decomposing dissolved hydrochloric acid, *i.e.*, two Daniells = 98 cal. Under these conditions the decomposition of the acid is very brisk, but, notwithstanding, no escape of gas appears at the positive electrode; at the expiration of an hour a few gaseous bubbles begin to form upon it. After 20 hours the decomposition still continues with escape of hydrogen at the negative pole, whilst oxides of chlorine are evolved at the positive pole. The liquid of the voltameter, if evaporated in the water-bath and then calcined in an atmosphere of coal gas, leaves a residue of perfectly pure platinum.

When employing two Daniells the results obtained on electrolysing different mixtures of hydrochloric acid and water have been always the same as those described above. We observe a limit of the action with a mixture of 10 per cent. of hydrochloric acid, and in fact the quantity of platinum dissolved is exceedingly trifling.

b. Dilute hydrochloric acid. The mixture was 5 cc. of strong acid (the same quality as that employed above) and 100 cc. of water.

On closing the circuit, gas is seen to escape solely at the negative electrode. After some time, the liquid of the positive branch of the voltameter takes a slight yellow colour, and strongly decolourises a litmus paper plunged into it. The current was allowed to pass for 100 hours, when the liquid, on analysis, was found not to contain the slightest trace of platinum. When operating upon solutions of hydrochloric acid more and more dilute, down to 1 per cent., the results obtained were always the same, which proves that whatever the dilution of the acid, there are constantly given off oxides of chlorine, accompanied perhaps by traces of free chlorine due to a secondary action. But are these oxides of chlorine due to the decomposition of the hydrochloric acid, or to the action of the oxygen of the water upon hydrochloric acid. This cannot be determined, for these two reactions may be produced as well separately as simultaneously.

In order to be sure that in the electrolysis of the hydrochloric acid there are really produced oxides of chlorine, I precipitated the liquid of the voltameter with a slight excess of silver nitrate; I then filtered and added zinc and sulphuric acid. After some hours the liquid was filtered and again treated with silver nitrate, which gave rise to the

formation of a precipitate of silver chloride. This re-action renders certain the presence of oxides of chlorine, and among them probably hydrochloric acid. I do not, however, think that in the electrolysis of strong hydrochloric there can be formed hypochlorous acid, for this, as soon as produced, would be resolved in presence of hydrochloric acid into water and chlorine.—*Comptes Rendus.*

Some Inferences from the Laws of the Ramification of Currents.—By M. Slonguinoff.—A battery is considered composed of m elements of different electromotive forces, $e_1, e_2, \ldots . e_n$, and different resistances, $r_1, r_2 \ldots . r_n$. If the elements are combined, sometimes in multiple arc and sometimes in series, the strength of the current (of the resistance ρ) in the outer circuit is greater in the first manner of combination when $\rho < \rho_1$, but in the second when $\rho > \rho_1$. So that—

$$\rho_1 = \frac{\text{E} \,\Sigma\, r_1 - \text{R} \,\Sigma\, e_1}{\Sigma\, e_1 - \text{R}.}$$

where E and R represent the total electromotive force and the total resistance of the battery for the case of parallel combination, so that—

$$\frac{1}{\text{R}} = \Sigma \frac{1}{r_1} \qquad \frac{\text{E}}{\text{R}} = \Sigma \frac{e_1}{r_1}.$$

The quantity of heat (measured mechanically) in the whole circuit with parallel connection is—

$$\text{J E} + \Sigma \frac{e_1^2}{r_1} - \frac{\text{E}^2}{\text{R}}.$$

Where J represents the strength of the current in the outer circuit. This quantity is greater than J E.—*Wiedemann's Beiblätter.*

A Thermoscopic Method for the Determination of the Ohm.—By M. G. Lippmann.—It will be remembered that M. Joule employed a calorimetric method for the determination of the ohm. The method we are about to describe differs from that of this eminent physicist merely by not requiring a measurement of the quantities of heat, nor a knowledge of the mechanical equivalent of heat, E. This latter point is not without interest, since in the calorimetric method of M. Joule, the final approximation is limited by the uncertainty which exists at present on the exact value of the number E, that is to say, the possible error is about 1-100th.

The wire whose electric resistance, r, has to be found, is placed in the middle of a vessel, fitted up as a calorimeter, and surrounded by an enclosure of constant temperature. Through the wire is passed an electric current, the intensity of which, i, is measured. The observer then waits until the vessel has attained a constant temperature owing to the heat liberated by the current. This circumstance is ascertained by means of a thermometer, or rather thermoscope plunged into the vessel. When this constant temperature is reached the current is interrupted, and a motor is set in action, which produces a friction in the vessel which already contains the wire. The heat disengaged by friction is substituted for that which was just disengaged by the electric current. It is arranged so that the stationary temperature may have the same value as before. We have then $r\, i^2 = \text{T}$, T being the work expended; hence the value of r. It is scarcely necessary to add that the friction apparatus must be fitted up at a certain point in the containing vessel, even when it is not in action, and that it must be provided with one of those known arrangements by which T can be measured. It is also more convenient in practice to begin with the friction and then to regulate the intensity, i, so as to reproduce the same constant temperature. Lastly, in an apparatus of great capacity, it may be advantageous instead of observing the stationary temperature, to note the speed of heating.

According to M. Joule's arrangement in 1867, the calorimetric method depends also on the measurement of i, and on that of the work produced when determining E; it involves, besides, two measures which eliminate each other in the final result, *i.e.*, the calorimetric measurement which accompanies the determination of E, and that which accompanies the passage of the electric current. These intermediate determinations involve causes of error, and corrections due to the imperfections of the calorimeters with which they are effected. We dispense with them, taking care to expend the work, T, and the electric energy, $r\, i^2$, in one and the same caloriscopic vessel. It is needless to know the quantity of heat liberated in this vessel, just as is the case with the tare in a double weighing, and the advantage obtained seems analagous to that which would result from replacing two simple, successive weighings, made with different balances and different weights by a double weighing on Borda's principle.—*Comptes Rendus.*

NEW COMPANY REGISTERED.

Lancashire and Yorkshire Electric Lighting Company (Limited).—Capital £100,000, in £5 shares. Objects: To produce and supply electric light, heat, and power, and also telegraphic and telephonic means of communication. Signatories (with one share each): J. Hargreaves, T. Richardson, and L. Rees, of Manchester; R. Smith and H. S. Gibbs, of Lymm, Cheshire; J. Witham, Southport, and E. Everitt, 11, Alfred Place, Westminster. The signatories appoint the first directors. Future directors will be required to hold shares or stock to the nominal value of £250. The shareholders in general meeting will appoint remuneration. Registered, 4th inst., by Best, Webb & Co., 6, Essex Street, Strand.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Eastern Extension, Australasia and China Telegraph Company (Limited).—The annual return of this company, made up to the 3rd of May, was filed on the 10th of May. The nominal capital is £3,000,000, in £10 shares. 199,750 shares have been taken up, and the full amount has been called and paid thereon.

Eastern and South African Telegraph Company (Limited).—The return of this company, made up to the 24th of July, was filed on the 16th August. The nominal capital is £40,000, in £10 shares, the whole of which has been subscribed for and paid up.

Direct United States Cable Company (Limited).—The annual return of this company, made up to the 3rd of March, was filed on 10th of March. The nominal capital is £1,300,000, in £20 shares. 60,705 shares have been allotted and 20 issued as fully paid. The full amount has been called up, the calls paid amounting to £1,214,100.

Eastern Telegraph Company (Limited).—The annual return of this company, made up to 16th of February, was filed on the 3rd of March. The nominal capital is £4,500,000, in £10 shares. 449,985 shares have been taken up, and the full amount called. The subscribed capital is £4,499,850.

Pall Mall Electric Association (Limited).—The return of this company, made up to 18th of February, was filed on 23rd of February. The nominal capital is £15,000, in £5 shares. 400 contributory shares and 2,600 vendors' shares have been taken up. Upon each of the contributory shares £2 10s. has been called, the calls paid amounting to £1,000. The vendors' shares are considered as fully paid.

British Indian Electric Light and Power Company (Limited).—The return of this company, made up to the 13th ult., was filed on 17th ult. The nominal capital is £250,000, in £5 shares. 301 shares have been taken, and £5 per share called thereon, but the calls paid are nil.

Anglo-Austrian Brush Electrical Company (Limited)—The return of this company, made up to the 24th ult., was filed on the 31st ult. The nominal capital is £500,000, in £5 shares. 40,268 shares have been allotted. Upon 26,668 shares £2 10s. has been called, 5,000 shares have been issued as fully paid, and 8,000 issued as paid up to the extent of £2 10s. The calls paid amount to £60,183, and considered as paid to £6,487.

NEW PATENTS—1882.

5241. "Electric time ball apparatus." W. R. Lake. (Communicated by Standard Time Company.) Dated Nov. 2.

5254. "Apparatus for driving tramcars and other vehicles by electricity." A. Reckenzaun. Dated Nov. 3.

5265. "Improvements in the method of utilising electricity for medical purposes and in the method of and apparatus for generating such electricity. T. Welton. Dated Nov. 4.

5273. "Clocks for signalling by electricity." W. R. Lake. (Communicated by Standard Time Company.) Dated Nov. 4. (*Complete.*)

5276. "An improved method of, and apparatus for, utilising the motive forces of waves, chiefly designed for the production and storage of electric energy." W. R. Lake. (Communicated by A. de Sonza.) Dated Nov. 4.

5278. "Manufacture of telegraph cables." G. E. Vaughan. (Communicated by S. Trott and F. A. Hamilton.) Dated Nov. 4.

5280. "An improved method of, and apparatus or devices for, signalling by electricity through the medium of gas (breaking and closing an electric circuit). W. R. Lake. (Communicated by Standard Time Company.) Dated Nov. 4. (*Complete.*)

5304. "Production of dynamo and magneto electricity by a self-sustaining and self-rotating process!!!" H. Mayhew. Dated Nov. 7.

5315. "Improvements in insulating compounds and in processes for the insulation of electric conducting wires and cables." J. Wetter. (Communicated by R. S. Waring and J. B. Hyde.) Dated Nov. 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1882.

1211. "Machinery for obtaining electric currents." H. E. Newton. (A communication from abroad by A. I. Gravier, of Paris.) Dated March 13. 6d. The object of the present invention is to construct in a cheap and efficient manner a machine capable of producing currents, or of converting a given current either into a continuous or into an alternating current, either in quantity or intensity.

1328. "Electric signalling apparatus, &c." L. J. Crossley, J. F. Harrison, and W. Emmott. Dated March 18. 6d. Relates to improvements in magneto-electric or electro-magnetic signalling apparatus for use in telephone exchanges, railway signal cabins, and for telegraphic and telephonic purposes generally, the improved signalling apparatus being also applicable to connecting and disconnecting wires used for telephonic, telegraphic and other purposes.

1347. "Machine for generating electric currents." S. E. Phillips. (Partly a communication from abroad by W. C. Johnson.) Dated March 20. 4d. On the outer edge of a disc made of any suitable material, but preferably of metal, a number of coils of wire are fixed, a double circle of such coils may, however, be fixed, one circle on each side of the disc, and held in position by lugs or projections standing out from the disc, or a single circle of coils may be made to drop into openings cut in the disc; in this way three complete circles of coils can be obtained if desired. For the pupose of completing the magnetic circuit of the iron cores on which the coils may be wound, wedge-shaped pieces may be fitted to fill up the space between the ends of the coils. The coils themselves may be wound on iron or wood cores of the same size throughout, the wire winding may be suitably stepped to make the outside surface of the coils when fixed form as nearly as possible a perfect circle, or the same object may be attained by giving the iron or wood cores a slight but sufficient bend, and winding each flake of wire to the full length, or the iron or wood cores may be bulged in the centre, so that when it is wound with the necessary number of full flakes of wire its outside surface will be suitably curved. Such a disc with its one, two, three or more rings of coils wound on iron or wood cores, or without cores, if desired, suitably fixed near its outside circumference, is mounted in the usual manner on a spindle running in suitable bearings, the disc being free to rotate between the poles of two or more electro or permanent magnets, the poles of which are so shaped as to surround, as far as possible, the coils of wire in a direction at right angles to the direction of their rotation. In this way these coils are made to pass through a very concentrated magnetic field and the wire of the coils will throughout a very considerable part of its length pass through the magnetic lines of force.

1363. "Secondary batteries." F. Maxwell-Lyte. Dated March 21. 4d. The inventor proposes to render secondary batteries more stable and permanent by avoiding the contiguity of the binoxide with the metal beneath it, he increases the electromotive force obtainable from any given volume or weight of battery by thickening to any required extent the spongy metal, thus increasing the storage capacity. He also does away once for all with any lead supports, substituting for these other inert and inoxidable conducting surfaces.

1366. "Working telephonic and telegraphic apparatus." A. E. Dolbear. Dated March 21. 6d. In all telegraphic and telephonic systems hitherto employed, arrangements have been provided for bringing the instruments into an electric circuit, which is completed either with a return wire or by the earth or through a condenser of sufficient capacity to the earth. The inventor has discovered that it is possible to work such instruments as telephones and the like, when entirely disconnected with any source of electricity or circuit by the varying strength of an electric field. An electric field is created about every substance or body that is electrified, and all objects within this field are attracted towards this electrified body. With a constant source or supply of electricity this field varies in strength and in form with, or according to, the form and extent of surface of the electrified body and the form and character of other bodies in its neighbourhood. The lines of force that make up this electric field are seldom straight lines, but are generally a complicated system or series of curves. The electric field may be created in any room or space by placing therein a metallic body in connection with a battery or other source of electricity. In order to employ this electric field for this purpose of the invention in connection with a telephone, the inventor places a suitable conductor, such as a wire, say, from one foot to three feet in length, so that its two ends shall extend into parts of the electric field having different strength. Therefore any change in the strength of the field resulting from a change in the electric tension of the body or bodies in electrical connection with the variable source of electricity, will give rise to electrical manifestations in the said wire or other conductor resulting in a transient current of electricity in the conductor or the usual phenomenon of the attraction of neighbouring bodies by the said conductor. If, then, an electric telephone-receiver be connected to one end of the short wire or conductor in such a manner that the other end of the same shall be in a part of the field, of a strength different from that occupied by the telephone-receiver, then any electric change that takes place in the field will so affect the plates of the receiver as to make them attract each other with greater or less force in proportion to the change or variation of the field. If the body which is to effect or create the electrical field (whether the same be the end of a wire or a metallic surface of any form and extent) is in electrical connection with the secondary wire of an induction coil having an ordinary transmitter and battery in its primary circuit, any change or variation of the current in the primary circuit will result in charging the line and its terminal bodies with electricity, and create in their neighbourhood a field which will vary with the strength of the electrical variations in the coil, and hence one may, by listening at the receiver, hear words spoken at the transmitter. If, instead of an electric telephone-receiver a magnetic telephone-receiver be substituted and the terminals be made to assume the proper positions, as above stated, in the electric field the speaking may be heard as with the first-named instrument, and with either of these instruments these effects may be observed at a distance of several feet from the metallic terminals of the same. The invention is illustrated by figs. 1 and 2. Fig. 1 is a diagram illustrating the existence of equi-potential sur-

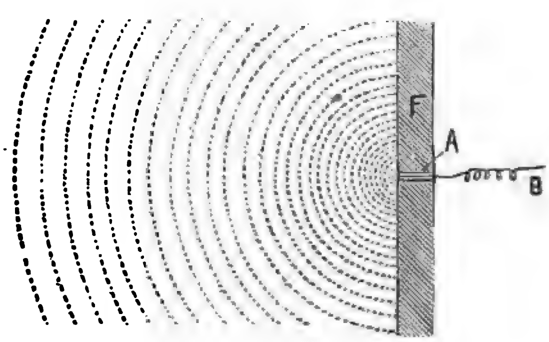


Fig. 1.

faces in the electric field produced by a body charged with electricity. Fig. 2 is a diagram illustrating the manner of using disconnected receivers in the electric fields of charged bodies. A is an insulated body connected to a wire, B, by which it can be charged with electricity as desired; the dotted lines in fig. 1 represent equi-potential surfaces in the electric field of the charged body, A, as they exist when that field is unaffected by other bodies. In fig. 2, A represents a wire which is insulated from the wall, F, of the room, F^1, representing the floor of the said room. T represents a telephone receiver, say, of the kind described in the specification of letters patent dated March 29th, A.D. 1881, No. 1395. Now if A be charged to a high potential (say by connecting the wire, B, with one terminal of the induction coil described in the said former specification) the whole room will be in the electric field of A. Now as this field will vary with the electric potential of A, the electric condition of the telephone-receiver, T, will vary with it, as a whole, just as the electric condition of any other body in the room and of the walls, floor and ceiling of the room will vary. But if one of the plates, t or t^1, of the telephone, T, have a conductor such as t^2, say, of a length of twelve inches or more, the end, t^*, of this conductor will occupy a surface of the electric field which has a potential very different from that of the surface occupied by any point in plate t^1 or in plate t, and the inventor has discovered that the telephone receiver, T, will under these conditions reproduce speech transmitted through the line-wire, B, whether the said receiver is held in the farthest part of the room, F, F^1, or in close proximity to the terminal, A. Moreover the movement of the receiver, T, from one part of the room to another has but a very slight effect, so that the listener may walk about the room and yet distinctly hear all that is spoken to the transmitter with which the line-wire, B, is connected, especially if there be a number of electrified bodies, A, in different parts of the room, each forming a terminal of the line-wire, B. Furthermore the number

of receivers in the room seems to be immaterial, so that many persons in one room, each holding a receiver to his ear, and each walking about the room can hear distinctly. When a magneto-telephone receiver, such as that shown at T^2, is used, the conductor, t^2, should be in electric connection with one end of the helix therein.

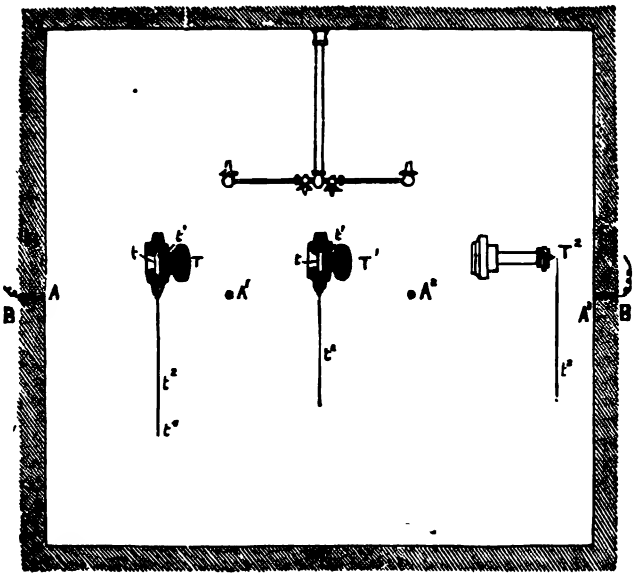


Fig. 2.

In practice the inventor usually employs a wire extending about three feet from one plate of the receiver or from one end of the coil of the magneto-receiver. When receivers are to be used in various parts of a large room, the line-wire should have a number of terminals, each brought into the neighbourhood of the place where a receiver is most likely to be used, as in fig. 2, where A A^1 A^2 A^3 represent four terminals of the line-wire, brought into the room, F F^1.

1367. "Providing earth connections for electrical currents." A. E. Dolbear. Dated March 21. 6d. Since the invention and during the use of the telephone great inconvenience has been occasioned by the difference of electrical potential between points at a distance of, say, more than about a mile from each other, this difference of potential being, in some instances, so great as to maintain a very considerable current of electricity in any closed circuit between the said points or places, and thereby cause great inconvenience in the working. Sometimes the current is strong enough to work the well-known "Morse" instruments without any other source of electricity. The reason is that the various batteries having terminals in the same place or neighbourhood charge the ground in the vicinity thereof, and in distributing the electricity any closed circuit extending to a place of lower potential will furnish a better conductor than the earth itself. It therefore becomes necessary to provide a "ground" possessing the additional quality of an unvarying zero potential, or as nearly so as possible. To accomplish this object the inventor proposes to extend the lines requiring such a "ground" to any convenient body of water of sufficient magnitude, and then connect the same with a suitable conducting body, say, a metal plate of sufficient area, and arrange the same in contact with the water. When two or more circuits are to find their "ground" in the same body of water they should be insulated from each other, and each should have a separate "ground" as far removed from the other circuit or circuits as practicable. The same arrangement should be provided at both ends of the line. Inasmuch as the ocean or large rivers and other bodies of water have a degree of conductivity much higher than that of the material of the land, it follows that their differences of electric potential will be less local in their action, and hence such bodies placed in water as above described, are less likely to have a notable difference of potential than any substance or body on land, and are, therefore, better suited to be the "ground" for such circuits as need to be free from the disturbances known as earth currents.

1368. "Electrical cables." A. E. Dolbear. Dated March 21. 6d. Relates to improvements in the construction of electrical cables, and is designed to render the same more efficient for the transmission of signals or messages. According to this invention, the inventor constructs cables that will be free from the degree of electric absorption which at presents limits the speed of signalling. For this purpose he uses air as the dielectric in contact with the whole, or the greater part, of the surface of the conductor; that is to say, the improved cables have their conductors surrounded, or nearly surrounded by an air-space, instead of being tightly embedded in a non-conducting material of high specific inductive capacity, such as india-rubber. This method of construction may be carried into practice by making the sheath hollow or tubular, so that the conductor lies in it touching only the bottom of the tube, or by wrapping the wire or conductor with some loose fibrous material, such as hemp, which by reason of its separate or open condition, will leave space for the admission of air around the conductor, which space cannot exist when the conductor is surrounded by the compact material heretofore used. An outer sheath, or covering, properly constructed, is used to impart the necessary strength to the cable, and to insure the retention of the air in the space surrounding the conductor.

1385. "Electric contact-making thermometer." J. Formby. Dated March 22. 6d. The object of this invention is the application and conversion of an ordinary horizontal thermometer, whether mercurial or spirit, into an electric contact making thermometer, maximum or minimum, or both, and the improvements consist in suspending and supporting the thermometer by a peg, through the medium of a cord connected with a screw or sliding bar secured to the thermometer, which will enable such thermometer, in its normal state, to assume a horizontal position, and also allow any variation in the height of the mercury or spirit column to make or break contact at any required temperature or temperatures, maximum or minimum. The underside of the thermometer is provided with two metal arches, one on either side the point of suspension, and insulated from each other, one making contact at maximum and the other at minimum. One of the ends of each of these metal arches dip into a mercury cup, so that metallic contact is always maintained, whilst the other ends make metallic contact only when required, through the medium of metallic adjustable strips of metal secured to a metal plate, forming the frame to which the terminals are secured. The said terminals are connected with wires leading to an electric battery as usual. The range between required maximum and minimum temperatures can be regulated by turning the suspending peg, so as to increase or decrease the distance from the mean point to be moved through by the contact-making points.

1390. "Driving, regulating, and indicating speed of dynamo machines." J. B. Rogers. Dated March 22. 6d. Relates, first, to a certain arrangement of apparatus by which the rotation of the wheels or axles, or one of them only, of a railway vehicle, can be utilised for driving one or more dynamo-machines fitted thereon, the dynamo being regulated by the apparatus, and maintained at an uniform speed, whether the vehicle be moving at a fast or slow rate of travel, the apparatus being more or less under control of an attendant, who travels with it. The apparatus is provided with reversing gear, to suit for running with either end of the carriage in front. Relates, secondly, to a speed travelling indicating apparatus, to be used in connection with the above-mentioned driving and speed regulating apparatus, or alone, if found desirable, or with other mechanism, whether of a travelling or other kind, and whether accumulators or secondary batteries be used in conjunction or not.

1392. "Incandescent electric lamps." D. Graham and H. J. Smith. Dated March 22. 2d. Relates to incandescent electric lamps, and has especial reference to improvements in the construction or formation of carbon, or other filaments, or plates for the same, whereby the electric current is transmitted with great regularity, and an equal light is maintained. *(Provisional only.)*

1400. "Incandescent electric lamps." T. E. Gatehouse. Dated March 23. 2d. Relates to electric lamps deriving their luminosity from the incandescing of a conductor in vacuo, and is designed to effect the objects claimed in inventor's Specification numbered 3240, and dated 25 July 1881, Claim I., in a similar but more simple manner, that is to say, the preservation of the incandescent conductor by means of the opposite physical properties of carbon and metals. In the said specification, in the compound conductor, platinum wire is used as an incandescent light giving material in conjunction with carbon, in parallel or alternative circuits, having their sections and lengths, and therefore their normal resistances, properly proportioned: the inventor now proposes to use an alternative method to obtain a like result. The present device consists of an incandescing conductor, formed in continuous circuit, of two materials of opposite electrical resistances with regard to temperature, conviently platinum and carbon. In this case the resistance of the platinum increases with a rise of temperature, whilst that of the carbon decreases. The sectional areas and lengths of the separate constituents are so proportioned (according to their respective properties) as to form a continuous conductor of more or less constant resistance, and in which, at times, both the constituents of the conductor would become luminous, irrespective of the leading wires fused in the globe. The arrangement conveniently adopted is to attach short lengths of platinum on both leading wires, bridged by a carbon loop, the whole being enclosed in an exhausted globe.

1405. "Electric gas-igniting apparatus." J. W. Urquhart. Dated March 23. 2d. The gas-igniting apparatus constructed according to this invention consists mainly of three parts, termed respectively the generator or battery, the intensifier, and the discharger. These three parts are combined in one apparatus of a portable shape or form, by preference cylindrical, and one in continuation of the other. (*Provisional only.*)

1412. "Electric lighting." O. E. Woodhouse and F. L. Rawson. Dated March 23. 6d. Relates to improvements in electric lamps deriving their luminosity from an incandescent conductor in vacuo, and is designed to effect more perfect reflection of the light from the globes of such electric lamps than has hitherto been effected, and to obtain a simple method of constant resistance in them and other electrical appliances.

1444. "Electric incandescent lighting apparatus." R. Wiedermann. Dated March 25. Relates to apparatus for the production of incandescent light by electricity. Fig. 1 is a vertical transverse section of one form or modification of the invention, and figs. 2 and 3 an elevation and a vertical section on the line, x, x, of another modification thereof. In these lamps a carbon pencil electrode, a, is kept in contact with a carbon or metal electrode, b (of larger cross sectional area than the pencil, a), either by springs, by a weight, or by liquid pressure. This carbon pencil is supported and enclosed in a tube which is, in some instances, hermetically closed at one end. Its other end has a disc provided with a central aperture, through which the carbon pencil, a, projects into a cylinder or globe of glass, which is screwed air tight upon the said tube, and which contains the other carbon or metal electrode, b. This electrode is connected with one pole of the source of electricity, the carbon pencil being connected by suitable means to the other pole. In the lamp shown in fig. 1, the inventor makes use of liquid pressure to keep the carbon

pencil, *a*, in contact with the electrode, *b*. For this purpose the inventor constructs the said lamp with a tube or cylinder, *c*, which is filled with mercury, glycerine, or other suitable liquid; *d*, is a disc or plate which closes this tube, *c*, at its upper end. To prevent incandescence of the carbon pencil, *a*, below, or beyond the desired distance from its point, *a**, which is in contact with the other electrode, *b*, the inventor fixes on the disc, *d*, a collar, *e*, of steatite, magnesia, or other material capable of enduring the heat caused by the incandescence of the carbon. This collar is so fitted to the pencil, *a*, that the latter can slide freely through the same, but the collar will absorb so much of the heat as to prevent the incandescence of the carbon below the said collar. The disc, *d*, has a rim, as shown, or other suitable provision, for the reception of the glass cylinder, *f*, which is hermetically closed at its upper end by the carbon or other block forming the electrode, *b*, and at its lower end by the liquid in the tube, *c*. *g*, *h*, are the terminals; the terminal, *h*, is secured to the rod, *i*, which is connected with the electrode, *b*, this rod being

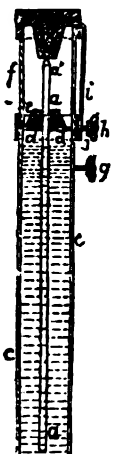


Fig. 1.

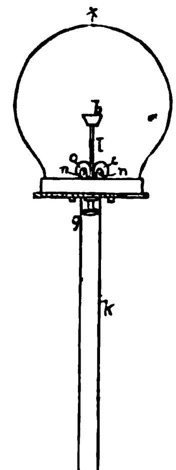


Fig. 2.

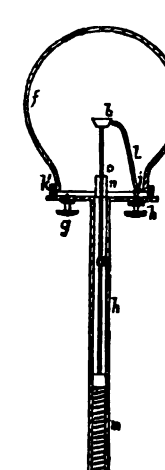


Fig. 3.

insulated at its lower end by a plate or piece, *j*, of any suitable material. Assuming that *g* is the positive terminal, the direction of the current will be from this terminal through the liquid to the electrode, *a*, and from the latter through the electrode, *b*, and the rod, *i*, to the terminal, *h*. When the part of the carbon pencil comprised between the collar, *e*, and the point of contact with the other electrode is heated to incandescence by the passage of the electric current, the small amount of oxygen in the lamp is soon consumed and the atmosphere of nitrogen, carbonic acid, and carbonic oxide, then contained in the same does not affect the carbon, and no further oxidation takes place. In the modification of the invention illustrated in figs. 2 and 3, *k* is a tube through which the pencil or electrode, *a*, extends into the globe, f^1; *l* is a metal rod or wire which carries the fixed electrode, *b*, at its upper end. The electrode, *a*, is kept in contact with the electrode, *b*, by means of a spring, *m*, enclosed in the tube, *k*, the latter being provided at its lower end with a screw cap or similar device to permit access to, and regulation of, the said spring. The disc, k^1, forms a base or holder for the globe, f^1, which is secured hermetically tight thereto. On this disc is fixed a bracket, or pair of brackets, *n*, for carrying the small metal grooved guide rollers, *o*, between which the pencil, *a*, is held and moves. The terminal, *g*, is fixed in the disc, k^1, and the end of the rod, *l* (which extends through the disc and is insulated therefrom), forms the other terminal, *h*.

1455. "Secondary batteries for the storage of electricity." G. Molloy. Dated March 27. 2d. Relates to improvements in secondary batteries for the storage of electricity. Each plate consists of thin sheet lead which is suitably folded, or rather, closely corrugated, and then fitted into a wooden frame. The several plates of each cell are coated with red oxide of lead and are fitted in frames. They are placed side by side in a rectangular box lined with lead. (*Provisional only*.)

1462. "Electric lamps." S. Waters Dated March 27. 2d. The object of the invention is to increase the illuminating power of electric lamps, more particularly of incandescent lamps, and at the same time give a more pleasing effect. The invention consists in forming one half more or less of the globe or flask of the lamp into a concave mirror, and this may be done by coating the glass externally with an amalgam formed from tin-foil and mercury, or by a deposit of silver produced by chemical action or deposition upon the exterior of the flask. The particular portion of the globe which is formed into a mirror will depend upon the position in which the lamp is intended to be used; for example if the lamp is to be placed against a wall the part or half of a globe nearest the wall will be formed into a mirror; if the lamp is to be overhead the upper portion will be converted into a mirror.

1464. "Electric piles or batteries." F. de Lalande. (Partly a communication by G. Chaperon, of Spain.) Dated March 27. 4d. The piles are characterised by the employment as a depolarising body of oxide of copper with which can readily be formed electrodes of good depolarising power and of good conductibility, especially when they have already worked and contain some metallic copper.

1465. "Carbons for electric lamps." A. Smith. Dated March 27. 4d. Relates to the production of carbonaceous filaments or rods for use in electric lamps, which is effected by a peculiar treatment of the substances known as Furfurol and Fucusol.

1496. "Dynamo or magneto-electric machines." T. J. Handford. (A communication from abroad by T. A. Edison, of America.) Dated March 28. 6d. The object of this invention is to provide methods and means for automatically regulating the generation of current by dynamo or magneto-electric machines supplying current for light, power, or other purposes, which methods and means shall be exceedingly efficient in operation, and shall not depend upon the use of adjustable resistances, which act to primarily vary the current flowing through the field of force circuit. This is accomplished by the use of a rapidly vibrating circuit controller, automatically operated by the current generated and serving to control and regulate the energy of the field magnet by rapidly and successively opening and closing a circuit. This circuit is preferably the field of force circuit itself, but it may be a circuit for drawing or shunting current away from such field of force circuit.

1516. "Material for electrical insulation." J. Imray. (A communication from abroad by La Société Anonyme des Cables électriques (Système Berthoud, Borel et Cie) of Paris.) Dated March 29. 4d. Relates to the production of the material for electrical insulation, consisting mainly in the transformation of a siccative oil into a solid elastic body. The process employed by preference for the production of this material is as follows:—A quantity of siccative linseed oil is heated to boiling point, or about 320° Centigrade, in a metal vessel, which is open so that the oil can be continually stirred, so that the part in contact with the atmosphere is always being changed. The oil becomes gradually of a darker colour, and at the end of a certain time, which may vary from twenty minutes to several hours, according to the quality of the oil, this becomes transformed into a solid elastic mass similiar to caoutchouc. This material by itself gives an insulation which is not perfect, and it has been found that colophonium mixed with the oil at the moment when the transformation from a liquid to a solid state commences, gives a material that has the same degree of insulation as the mixture of colophonium and paraffine, which has been employed as insulating coating for telegraph cables.

1526. "Transmitting and printing telegraphic messages." W. R. Lake. (A communication from abroad by A. F. Johnson and F. B. Johnson, both of America.) Dated March 29. 10d. Relates to automatic printing telegraphs and provides means whereby messages can be sent very rapidly and with great economy inasmuch as but comparatively few employés, and no skilled operators, are needed in practising the same. The said invention consists in an improved method of, and improved mechanism for, transmitting and printing messages by electro-magnetic telegraph.

1548. "Secondary batteries." W. B. Brain. Dated March 30. 6d. The object of the invention is to extend the capacity for storing the electric energy without increasing the electrical resistance; also to simplify the construction and to render such batteries more convenient in use and less liable to get out of order, and doing away partly or wholly with the diaphragms of felt, flannel, parchment and the like. For this purpose the inventor forms chambers, bags, or closed envelopes of thin sheet lead and encloses the oxidising and deoxidising agent, such as red lead, therein, and he forms holes through these envelopes, one set of holes being forced through from one side and another set of holes forced through from the other side, and these holes are depressed or bulged all round and have more or less burred edges, by this means the red lead is retained in the envelopes, while at the same time it is kept in metallic contact and renders the thin walls of the envelope stiffer.

1555. "Telephones." J. H. Johnson. (A communication from abroad by C. G. Rodrigues-Pereire, of Paris.) Dated March 30. 2d. Relates to an improved system of differential telephone acting as receiver and transmitter, and provided with a coil of special construction acted upon simultaneously by differential currents, being also common to the transmitting microphones and to the receiving telephones. (*Provisional only*.)

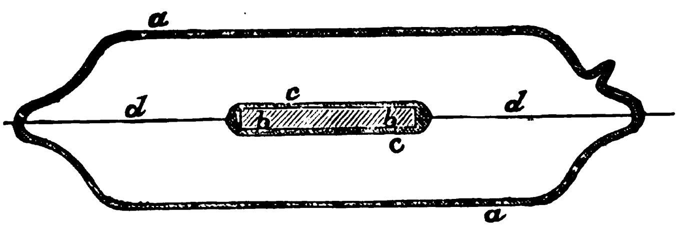
1556. "Generation, storage, distribution, regulation, and utilisation of electricty." J. S. Williams. Dated March 30. 1s. 4d. Has for its object the utilisation of electricity and relates to the collection, concentration, condensation or storage of the same, and to methods, apparatus, and means employed therefor and therewith, and for its distribution, regulation, measurement, and conversion or translation into light, heat, or motive-power.

1570. "Electric arc lamps." W. Jeffery. Dated March 31. 6d. Chiefly refers to the arrangements for regulating the arc. For this purpose the inventor makes the lower or negative carbon a fixture; the upper or positive carbon, or the wood or other rod to which it is clamped is free to slide through a tube or guide; to this a flexible loop or ring, say, of india-rubber, is connected, through which the positive carbon or positive carbon holder passes, the opposite side of this loop or ring is connected to the armature of an electro-magnet, for instance by a lever which is jointed at its other end to another piece or lever having its fulcrum on a bridge. The opposite end of this lever is provided with an armature which is acted on by an adjacent electro-magnet or solenoid; when the armature is attracted by the magnet the elastic ring is tightened and the carbon thereby gripped and lifted the required distance to produce the arc; the armature released the elastic ring contracts and the carbon is free to slide through same. The loop or ring is by preference placed in a slanting position. A series of carbons arranged in the manner before described may be fitted along side one another in a ring, or as desired, in one and the same lamp.

1574. "Apparatus for augmenting or strengthening electric currents for telephonic purposes." W. R. Lake. (A communication from abroad by J. Moser, of Berlin.) Dated March 31. 6d. Relates to electric telephonic circuits and appartus connected therewith, chiefly designed for transmitting sounds from theatres, exchanges, or other places. Hitherto the application of the telephone for theatrical purposes has necessitated the use of a great number of conducting wires, and has consequently occasioned a

heavy outlay or expense for fitting up the apparatus. This defect is due to the weakness of the telephonic current, which permits of only a very small number of receivers being placed in the circuit of one transmitter. The object of the said invention is to strengthen or augment the telephonic or induced current in order to reduce the circuit to a single wire capable of supplying a number of telephonic receivers, and thus effect great economy in the cost of fitting up the apparatus.

1580. "Electric lamps." SIR DAVID SALOMONS. Dated March 31. 6d. Has for its object improvements in electric lamps. In carrying the improvements into effect the lamp may be arranged to produce light either in vacuo or in any suitable gas, or in the air, and the light may be protected by a glass globe, tube, cylinder, or other shaped glass or other transparent, semi-transparent, or opaque mineral or other covering, either in contact with the incandescent substance giving light or leaving a space around it, or giving light indirectly through heating the covering or coverings as aforesaid in contact with or in close proximity to the incandescent substance.



The figure represents an electric lamp constructed according to the invention—*a*, *a* is a glass tube of any suitable size and proportions; in the interior of this glass tube is a stick or block of baked pipe clay, *b*, coated about one millimetre thick with a composition, *c*, formed, for example, of equal weights of plumbago, charcoal powder, and sugar. A platinum wire, *d*, is fixed in each end of the parts, *b*, *c*, and the entire mass is subjected to a white heat in a closed vessel for about six hours, the glass tube, *a*, *a*, is sealed around the wires, *d*, *d*, and it is exhausted by a "Sprengel" pump.

1587. "Secondary batteries." ALFRED TRIBE. Dated April 1. 4d. Relates to improvements in the construction of secondary batteries, and consists in the employment of a negative plate or plates composed of peroxide of lead, the same being either in a compressed or solidified form or in other suitable condition.

1600. "Electrical apparatus for employment in the indicating and extinguishing of fires." G. W. VON NAWROCKI. (A communication from abroad by Felix Bahr, of Warsaw.) Dated April 1. 6d. Relates to improvements in apparatus for extinguishing and indicating the outbreak of fires in buildings, and consists in the employment of electrical apparatus for the purpose. To this end the wires from an electrical apparatus are carried through the room or rooms of the building having connected therewith any suitable form of contact apparatus so constructed that on an outbreak of fire they close the contact or current, which action causes an armature to open a water tap of a pipe connected with the water main, and allow the water to flow from suitable pipes arranged in any convenient manner within the room or rooms.

1611. "Electro-magnetic and regulating apparatus for electric lamps, &c." W. R. LAKE. (A communication from abroad by E. Weston, of America.) Dated April 3. 2d. Relates to electro-magnetic apparatus, and is designed especially for use with electric lamp regulators or in similar devices, the chief objects of the said invention being to produce a magnet which, while occupying a very small space, shall possess great attractive power. (*Provisional only.*)

1614. "Magneto or dynamo-electric machines." W. R. LAKE. (A communication from abroad by E. Weston, of America.) Dated April 3. 6d. Relates to that class of electrical generators which have an armature wound with a number of coils, the ends of which are united to form an endless wire, and from which loops are taken off from the junctions of the originally separate sections of wire on the said armature and united to the separate insulated segments of the commutator. The invention consists essentially in winding the armature with two or more independent endless wires and so connecting them by loops to the commutator segments as to avoid having any two adjacent strips of the commutator connected to loops from adjacent coils on the armature. This prevents any accidental short-circuiting of the coils.

1616. "Production of electric currents." W. B. BRAIN. Dated April 3. 2d. According to this invention the inventor winds the wire round the induction core, the wire remaining stationary, and the core revolving inside same. (*Provisional only.*)

1626. "Electric light and power apparatus." J. MUNRO. Dated April 4. 8d. Relates to improvements in apparatus for generating and producing electric light and power. For distributing the current the inventor employs a combination of the known rotary or vibratory distributing devices whereby a current is dealt out in portions to a number of separate circuits in turn and a secondary battery or other means of re-uniting these parcel currents into one continuous current for each circuit. The inventor finds that secondary batteries give a steady current when charged intermittently in this way, and he makes special provision for adjusting the period of charging and non-charging the accumulator, or, in other words, the duration of the [illegible]rent and the interval between the pulses. The rotating distributor may be separate from the generator and driven by its own belt, clockwork, or motor, but it may also be applied to the generator so that it is driven by the latter.

1640. "Dynamo-electric machine." R. KENNEDY. Dated April 4. 6d. Relates to an improved dynamo-electric machine, and has for its object to obtain several currents of electricity from one continuous rotating wire. It has also for its object to provide for four, eight, or other even number of fixed magnetic poles greater than two, and to generate electricity as the armature is passing between two similar poles as well as between dissimilar poles.

1647. "Manufacture of incandescent electric lamps." ST. GEORGE LANE-FOX. Dated April 5. 6d. Consists of improvements in the manufacture of incandescent electric lamps, and it relates to the thickening of the ends of the carbon filaments in order to reduce the resistance at those parts, and thus prevent excessive heating of the platinum or other conductors to which the carbon filaments are connected.

1649. "Underground conduits for electric wires, &c." A. J. BOULT. (A communication from abroad by J. D. Thomas, of America.) Dated April 5. 6d. Relates to improved means for, and a method of, protecting electrical wires that have to be laid underground. According to this invention electrical wires, such as used for the purposes of telegraphy and for telephonic and electric lighting apparatus, are placed into a conduit of special construction and are preferably embedded in the material hereinafter named. In the said conduit provision is made for ready access to the wires and for readily "tapping" and repairing the same.

1670. "Incandescent electric lamps." J. JAMESON. Dated April 6. 4d. The inventor deposits the carbon from which the filaments for incandescent electric lamps are to be formed within a tube of refractory material as regards endurance of heat from hydro-carbon gas or vapour, subjecting it to such condition as regards heat and pressure and the gas or vapour supplied as to produce a deposit of great density and uniformity of structure. When the deposit is formed of considerable thickness, the inventor breaks off the envelope employed in its formation, and then to give endurance to the cylinder so formed fills the inside with a tenacious cement such as resin or shellac, and saws off a series of discs, or grinds them off with sand and water and a hoop iron saw, so as to reduce the deposit formed to a series of thin rings, or he cements the end from which a disc or ring is to be cut to a plate so as to give the disc increased endurance while it is being cut.

1697. "Incandescent electric lamps." THE HONOURABLE R. BROUGHAM and F. A. ORMISTON. Dated April 8. 6d. Consists in placing the exhaust tube in incandescent lamps in a new position so as to improve the appearance of the lamp, and also relates to improved means of sealing in the wires where they pass in through the closed end of the cylindrical stem, and also to improved means of securing the extremities of a carbon filament to the extremities of the conducting wires.

CITY NOTES, REPORTS, MEETINGS, &c.

THE FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).

ON Monday an extraordinary general meeting of the shareholders of the above-named company was held at Cannon Street Hotel, under the presidency of Sir A. J. Otway.

Mr. Herbert Canning, the Secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, I have called you together to-day in pursuance of this notice, and I hope you will consider that I have had sufficient reason for so doing. I am one of those who think that commercial matters differ in this respect from political or diplomatic matters, inasmuch as there is really very rarely any reason why there should be any mystery or secrecy about the thing. My system has always been to take those who are partners with myself in a concern into my confidence. I have never understood why shareholders should not be as well informed about the affairs of a company as those who administer them. (Hear, hear.) If that principle, gentlemen, is a sound one, I need offer you no excuse for asking you to come here to-day to consult with us and give us the benefit of your opinion as to a proposition which has been made to alter the lines of policy on which the directors had previously decided to act. That is the cause in short of my asking you to come here to-day. You are aware that last June when we met, I, as the mouthpiece of the board, asked the shareholders to consent to certain lines of policy on which the affairs of this company were to be carried out. We have acted on the decision come to unanimously at that meeting, and we have continued so far as we have gone to further the interests of this company according to the ideas that were advocated at that meeting. We have made considerable progress in so doing. It may be necessary later to refer to these matters in detail, and if any gentleman wishes to ask any question about any detail it will be my duty to answer it. At present we have a matter of very great importance before us. Perhaps our proceedings had better take this course: a proposition will be submitted to you of a very important character. You will hear what can be said in support of that proposition, and you will have to decide upon it. It may be that some of you, if not all, may wish to hear the opinion of the directors on that proposition. If so, it will be my duty to submit to you my frank opinion on the ma[illegible] I would rather that you heard that proposition stated by th[illegible] [illegible]ms the most responsible for it. I shall call upon the gentlem[illegible] [illegible]nected, to pounded this policy to tell you what it is. This c[illegible] [illegible]l bein[illegible] such circumstances that three-quarters the entire [illegible] [illegible]amp[illegible],183, hands of very few gentlemen, of whose voices [illegible] [illegible]p the exponent. If he propounds a policy which

advantage and greatly to the advantage of the company, it would be very unwise and very unfair and very improper in a person so situated not to take the opportunity of making himself heard before the company. We owe to the outside public a defence of any interests of those who dissent from that policy. Of course it is the duty of the board to protect all its shareholders if they consider that their property is unduly attacked. It will be the duty of the board to interpose between such a policy as far as they can and those who differ from it. I am not going to pronounce any opinion at this moment upon the policy. I only ask you to recognise that the board has the interests of the shareholders at heart. I understand that M. Philippart dislikes addressing you in English. He is afraid of his accent, and he thinks he can do you better justice if he has read to you what he has written out by some other person.

The Solicitor of the company then read the following address of Monsieur Philippart: Gentlemen, before expounding my programme to you, I wish cursorily to refer to the fact that when our company was formed I submitted this same programme to your directors, stating to them that in the opinion of the vendors it was the best, indeed the only one, which would insure prompt and large dividends. For reasons which, if they deemed it fit, my colleagues will be certainly better able to explain to you than myself, this programme was not adopted by the board. In consequence difficulties arose between them and the vendors, of which you were made aware at our first statutory meeting, and which brought about an arrangement between myself and another company, who were the proprietors of an accumulator which could not possibly compete with the Faure accumulator. Consequent upon these arrangements I entered into an arrangement, which was afterwards approved by your directors and adopted by you at our meeting held on the 29th of June last. You will recollect, gentlemen, one principal clause of the agreement accorded to our company the option of purchasing the Faure, Sellon, and Faure and Volckmar patents for France and the rest of the European continent. When the agreement just referred to was formed by you your directors invited me to take a seat at the board. From that moment I persistently endeavoured to convince my colleagues that it was desirable to abandon the policy they had adopted for that which I had from the outset proposed to them, and which could still be successfully carried out. I did not succeed without great difficulty, and in order to obtain success my friends and I had recourse to an irresistible argument. We became proprietors of three-fourths of the ordinary shares of your company. We already held all the deferred shares. In the face of such a proof of confidence in my projects and my policy as that accorded by my friends, only two courses remained open to the gentlemen who constituted your board, one to resign the direction of your company in favour of myself and my friends, or to act in union with us. The first would be the readiest for my colleagues to have adopted, but would have been most deeply and sincerely regretted by my friends and myself; we would have made any sacrifice rather than that should occur. I have, therefore, incessantly endeavoured to convince them that the policy I foreshadowed was the policy most advantageous to you, gentlemen, and hence this day's meeting. My colleagues, in their loyalty to you, did not wish to change their policy without your full and entire approbation. We come from Belguim, whose motto says "Unity is strength;" we wish for unity and mutual confidence. The Société la Force et la Lumière has made you the offer which has been accepted by many of you, and would, in all probability, have been accepted by the greater number, if not, indeed, by all, had it been thoroughly understood. We have been asked for explanations which could not have been given before to-day's meeting. It is only necessary to set forth our programme. This programme is clear and simple. Our company must henceforward cease to be an industrial company manufacturing accumulators for sale, or for its own use, and must become a company for the formation and institution of the affiliated companies, to which companies we shall sell licences for cash, and for cash and fully paid up shares; also for the sale of licences to private individuals, and already existing companies. In this way we should readily make large profits, 10, 15, or 20 per cent. on the capital invested may be by this policy made. Profits which may and should satisfy local companies will not suffice for us, gentlemen. We should look upon ourselves as the sole possessors of one of the greatest inventions of the age. Take an example in justification of your policy. Supposing we had, 40 years ago, a gasometer having valid patents for the whole world, and that we had contented ourselves with making gasometers to order, for sale, instead of establishing, say, certain works to light a part of London; had we simply done this we should have been considered insane. An accumulator is as indispensable an element in electric lighting as a gasometer is to gas lighting, with this difference, that the future of electricity is ten times greater than that which could be attained by gas. The only practical and economical accumulator is the Faure. Everything leads us to believe that it will not be surperseded, and we are the owners of the Faure accumulator. Sir Henry Bessemer, whose large fortune shows the value of a great invention, has, looking ahead, stated publicly and repeatedly that by means of electricity power and light will be generated at the pit's mouth, and be thus communicated by wires, just as thought and sound are now communicated by the telegraph and the telephone. These profits can only be obtained by our co-operation. Ought we to be satisfied with being simply manufacturers of electrical reservoirs? No, gentlemen! with your permission we will do greater things. If large profits are to be realised by electric lighting in England, how much more so on the Continent, where light and power cost 50 to 100 or even 200 per cent. more than in England? Therefore we should purchase, re-sell, and farm the French and continental patents. To do this it will be necessary to make a call. We must have funds, and it will be necessary to call up £8 per share on the 40,000 shares of this company. These calls should be made forthwith. You need only pay £1 per share per month, according to the Articles of Association. But in order to facilitate payment in advance, la Société la Force et la Lumière offers to give you one £10 fully-paid share in exchange for two of your shares, with £2 paid, which you hold in the Faure Accumulator Company. We shall ask for a quotation for the fully-paid shares in our company at the beginning of the year. It is to the evident interest of all to make payment of the calls in advance. Those who do not feel disposed to make that payment in advance will probably accept the proposal made to-day by the Société, which not only relieves them of all further calls, but gives them in addition a profit of £3 on every share that they hold in the Faure Company. The offer made will remain in force till 12 o'clock on Friday next, the 10th inst.

Mr. Campbell said that the shareholders would like to understand something of the object with which the alteration was made; why should such a premium be given without an explanation of it?

A Shareholder said that, as the owner of 150 shares, the offer made seemed to him to be a very good thing to accept. If anybody knew anything more about it than did the shareholders he would be very glad to hear it—anything on the *per contra* side.

The Chairman said that the shareholders had got two courses only to pursue in regard to the matter. Those who thought their position very valuable should retain their shares with the £8 liability upon them. If the shares went to a very large premium they would have a reward for their confidence. Those who thought less well of the business, but who wished still to retain an interest in the Faure Company, should accept the offer of the Société la Force et la Lumière—viz., give one share fully paid up for two £2 shares. If they asked the object of the Société the answer was clear: They had that confidence in the goodness of the concern that they were prepared to give them £3 advantage, because they thought the shares would produce them a greater advantage still.

A Shareholder asked what would be the alteration of the scale of voting under the proposed transfer?

The Chairman said they had better consider that matter later on.

Another Shareholder asked who would be the new directors? Would there be any?

The Chairman said there was no resolution before them yet, and there would be no new board. This was a proposition to depart from the lines of policy hitherto adopted, viz., manufacturing accumulators. He regretted that a constructive company had not been established, and that it had only come about in this way. Shareholders had said to him, "The Brush Company has made enormous sums of money, how is it that the shrewd, going people of the Faure Company have made no money at all?" It was simply because they had been endeavouring to perfect an instrument which would give them profit. More enterprising men had said, "Let us sell these licences to other companies in a country like France, where the conditions are more favourable than in England; the price of gas being so much greater in France than in London—it being double, for instance, at Lyons. Let us seek the means of making more money. We have the power of becoming possessors of the French patents. Therefore pay your calls and do so." He had better tell them what he meant to do himself as an indication of his views. He meant to effect an exchange. They had the option of doing the same. It seemed to him that he got relieved of all kind of liability by the sacrifice he was willing to make for that purpose. It would be disagreeable to him to pay up £8 on his shares, and more disagreeable on the part of his friends who were interested in the Faure Company. When this offer came to him what struck him about it was its liberality. What disappointed him was that the offer extended only up to the day of the meeting. That he thought was very unfair. Monsieur Philippart saw the justice of his objection, and said he would extend the time till Friday, though he (the Chairman) had asked only for Tuesday or Wednesday. So that they could go quietly home and turn it over in their mind. The pecuniary success of course will depend on the success of those who will carry on the enterprise in France. If companies were constituted there there could be no doubt that the profits would be very large, but if they should fail they could judge what their position would be under those circumstances. At any rate they would be relieved of all liability on the 1st of January by effecting this exchange.

The Solicitor said he had failed to read a part of the address, which went on to say: "If our programme be adopted and our policy be followed, the Société la Force et la Lumière undertake to pay up in full before the 1st January next all shares, including those which you respectively transfer to us, so that no ulterior responsibility can attach to the first shareholders in the Faure Company." He trusted that that was an explanation which would be considered satisfactory (hear, hear).

In answer to a question, the Chairman said, unquestionably the board had full power to do all they were now about to do themselves, but he thought it right that the shareholders should know what the state of things was, and that they should give the board their opinion and wishes.

A Shareholder: How much will the company have to pay for the purchase of the patents?

The Chairman said the figures were set forth in the agreement of autumn last with the Storage Company. Those figures were very large. He was not carrying out the undertaking that was before them; but he felt himself authorised to say this, that he had heard it stated that the figures for which those patents could now be purchased were less than those which were offered to the company in autumn last.

A Shareholder remarked that he thought they ought not to sanction any alteration of policy until they knew something more. They had no figures, for instance.

In answer to another question, the Chairman said the Faure Company did not buy the patents at all; which could now be had much cheaper than some time ago. Another company would be constituted to purchase the Faure patents. Their proposition was only that this company should take an interest in the new venture—that they should take some interest in the new company supposing they became purchasers of the Faure accumulators.

A Shareholder: I understood that calls were to be made for that purpose.

The Chairman: Only to take an interest; not to purchase.

A Shareholder inquired whether the Société la Force et la Lumière were the proprietors of these patents. The shareholders, he thought, ought to know something more about them.

The Chairman replied that whatever the condition of the society now, they bound themselves to be the holders of sufficient paid-up shares to give to every shareholder of the Faure Company one £10 share fully paid-up for two £2 paid shares. The Société la Force et la Lumière owned all the shares of this company with the exception of 9,000 shares; and what they had to find was sufficient to pay these 9,000 shares. Of course a gentleman would not part with his two shares on a promise of receiving a fully paid share hereafter.

Another Shareholder said he should like to know if the Société la Force et la Lumière were in a position to carry out this arrangement.

The Chairman said he knew nothing more about the matter than the shareholders did. He brought them together in order to tell them all about the matter.

A Shareholder remarked that if they did not think it was a good thing, on the 1st of January they would be in the same position that they were in now.

The Chairman said this was an offer not made by the Faure Company. It was an offer by the Société la Force et la Lumière. All they had to see on the 1st of January was, that if they gave up their shares they got their full value for them.

Mr. Oliver asked if it was the intention of the new company to increase the number of shares, because if so, it was giving with one hand and taking away with the other.

Sir Charles Clifford said he thought they had proof of the *bona fides* of the company in the offer itself. The Société la Force et la Lumière not only offered to give them one share fully paid for every £2 paid share transferred, but they also felt themselves sure of obtaining the money necessary to do so; and they further felt themselves sure of finding out a larger field for operations to follow upon the transaction. He thought no gentlemen would put forward such a proposition without having influence and money at their backs.

The Chairman: If the Société la Force et la Lumière have not unlimited money, they have unlimited confidence.

The following resolution was then proposed by Mr. A. B. Bremner, seconded by Mr. Tucker, and carried unanimously, that "This meeting considers it expedient that the company take an interest, by purchase or otherwise, in foreign patents and inventions in foreign countries, especially in France, for accumulators and all other modes of electricity for lighting, motive-power, &c., and especially in the patents granted to Faure, Sellon, and Volckmar; and for that purpose, if found expedient by the directors, to assist in the formation of a company or companies in England or abroad, for the purchase, working, and carrying out of the said patents and inventions, and also, if expedient, by the directors, to subscribe for shares or take a pecuniary or other interest in the proposed company or companies, to such an amount and on such terms and conditions as the directors of the Faure Company may from time to time think advisable, and to pass such resolution or resolutions with reference to the foregoing as the shareholders may determine."

The Chairman then proposed the following special resolution for altering the scale of voting by the shareholders, as at present prescribed by Clause 64 in the Articles of Association of the Faure Company, and to substitute a clause in lieu thereof in the following terms:

"That, on every question to be decided by a poll, every member present, in person or by proxy, shall have one vote for every ordinary share up to ten inclusive, and he shall have an additional vote for every five shares beyond the first ten ordinary shares up to 100 inclusive, and an additional vote for every ten ordinary shares beyond the first 100 shares. And the holder of every ten deferred shares shall have the same number of votes in respect thereof as if they were one ordinary share, every ten deferred shares being, for the purposes of voting, always equivalent to one ordinary share. No member shall have more than 500 votes in all, and no member shall be entitled to vote on a poll as the holder of any shares in respect of which he shall not have been registered for three calendar months previous to the meeting."

The Chairman explained that by the 64th clause as it at present stood, if a man possessed 9-10th of the company's property, he could only have 50 votes. He thought it desirable even with the alteration, that a man should not have such an enormous number of votes that he could do what he liked personally with the company by means of his votes, therefore they proposed to alter that article to this extent, that in no circumstances shall he have more than 500 votes, but that he may have more than 50. We simply propose to make the 50 into 500. This was a question for director as well as shareholder. He moved the adoption of the resolution.

Sir Charles Clifford seconded, and the motion was carried.

A vote of thanks to the chairman concluded the proceedings.

New Cable.—For some time past the press of British Columbia has been attacking the Dominion Government for refusing to allow an American company to lay a cable across Puget Sound, from Point Angelos, on Washington territory, to Victoria, on the British Columbia side. On inquiry, however, says the *Journal of Commerce*, at the offices of the Government telegraphs at Ottawa, it has been ascertained that it is the intention of the Government to lay a cable next year, to form part of the telegraphic system of British Columbia, and for this purpose an appropriation will be asked next session. The object of laying a cable from Victoria to Point Angelos, a distance of 16 miles, is to connect with the United States Government line, which it is understood will be built from New Dungeness to Cape Flattery, the extreme north-west point of Washington territory.

Winding-up Electric Light Companies.—To-day, before Mr. Justice Chitty, petitions will be heard for winding-up respectively the "Birmingham and Warwickshire Brush Electric Light and Power Company," the "Brush Midland Electric Light and Power Company," and the "Devon and Cornwall Electric Light and Power Company." A petition for the winding-up of the "Yorkshire Brush Electric Light and Power Company" will also be heard shortly.

London Platino-Brazilian Telegraph.—A dividend of 2s. 6d. per share, free of income-tax, has been declared, payable on and from Thursday last.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Quotations. Nov. 8, 1 O'clock.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9½-10	[illegible]
		Do. Do.	10	19 - 22	20¼ 1
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1¼- 1¾	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½- 1½	1
25,000	5	Great Western Electric Light & Power Co.	2½	½- 1½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	5 -5½	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1 - 1½	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- ¾	[illegible]
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1¼- 1¾	1½
..	..	South African Brush Electric Light & Power Co.	2½	¾- 1¼	
100,000	5	Swan United Electric Light Co., Limited	2	1½- 2½	2
		TELEGRAPHS.			
2,116,400*l*.	Stk.	Anglo-American, Limited	100	49 - 50	
2,441,800*l*.	Stk.	Do. Preferred } Def'd. receiving no div. until	100	80 - 81	81,80¾
2,441,800*l*.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	19 - 20	
130,000	10	Brazilian Submarine, Limited	10	12 -12½	12⅛
16,000	10	Cuba, Limited	10	9½- 10	9¾
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6 - 6½	6¼
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	12,11¾
100,000*l*.	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10⅛-10⅝	10½ [illegible]
70,000	10	Do. 6 per cent. Preference	10	12¾- 13¼	13,12⅞
232,000*l*.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l*.	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l*.	100	Do. 5 do. do. Aug. 1899	100	103 -106	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½- 11¾	11⅝
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	104 -107	
140,000	100	Do. do. registered, repayable 1900	100	103 -106	
100,000*l*.	100	Do. 5 per cent. Debenture, 1890	100	101 -104	
254,300*l*.	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l*.	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6⅜- 6⅝	6½
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	12⅝
125,000	10	Great Northern	10	12½- 12¾	12⅝
100,000*l*.	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	27 - 28	27¼
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	30½- 31½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 4¾	
12,000	10	Mediterranean Extension, Limited	10	1½- 2½	
8,200	10	Do. 8 per cent. Preference	10	8 - 9	8½
9,000	8	Reuter's, Limited	8	12½- 13	
280,000	Stk.	Submarine	100	245 -255	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	102 -106	104
37,350	12	Telegraph Construction and Maintenance	12	32 - 33	
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	5½- 5¾	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7½-7¾	[illegible]
200,000*l*.	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	121 -124	
1,030,000*l*.	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1½- 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	7¼
4,669	10	Do. 6 do. 2nd do.	10	5½- 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	1⅛
300,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	½- 1	[illegible]
100,000	5	United Telephone Co.	5	10½- 10¾	

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company (Limited). The number of messages passing over the lines of this company during the month of October was 2,172, estimated to produce £2,000, against 2,145 messages, producing £2,192, in the corresponding month of last year. The July receipts, estimated at £2,[illegible], realised £2,921.

The Direct Spanish Telegraph Company (Limited). The estimated traffic receipts for the month of October, 1882, are £2,079, as against £2,063 in the corresponding period of last year.

The Eastern Extension Telegraph Company. The traffic receipts for the month of October, 1882, were £29,925, against £31,164 in the corresponding period of 1881.

The Eastern Telegraph Company. The traffic receipts for the month of October, 1882, were £58,173, against £48,572 in the corresponding period of 1881.

The Great Northern Telegraph Company. The traffic receipts in October, 1882, were £21,440, and from 1st January to 31st October, 1882, £203,280. In the corresponding months of 1881, they were £201,359, and in the corresponding months of 1880 £198,991.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending 3rd November, 1882, were £2,254, after deducting the [illegible] of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 260.

THE ELECTRIC LIGHT COMPANIES.

At the present moment the prospects of lighting by means of electricity do not look particularly inviting at the first glance, for the action which has been taken by shareholders in some of the subsidiary Brush electric light companies appears to have caused a slight reaction, or at any rate a temporary lull in the progress of the "light of the future." This, however, is unwarranted, and we think that the time has now arrived for the public to be guided more by the utterances of those journals devoted to the subject of electrical science, rather than by their own judgment, or the unstudied descriptions of the various competing systems appealing to the public purse, which appear in the daily press. On Saturday last three petitions were down for hearing before Mr. Justice Chitty, for winding-up respectively the "Birmingham and Warwickshire Brush Electric Light and Power Company," the "Brush Midland Electric Light and Power Company," and the "Devon and Cornwall Electric Light and Power Company."

Why is it that these companies have not got to work? Was it that they could not contract to give the electric light at the same price as gas, light for light; had they not the apparatus wherewith to supply the public demands; is it that the action of local authorities in the districts over which these companies held control damaged their interests; or is the public in the above-mentioned localities averse to trying the electric light? We cannot believe the latter to be true, nor *should* the question of price be the cause, for did not the Anglo-American Brush Electric Light Corporation illuminate for one year part of our City for less than had previously been paid for gas, and did they not contract for another year at a price but slightly in excess of it?

We must look, therefore, to some other cause to explain the motive of certain shareholders in these subsidiary Brush companies, and consider whether the uncertainty existing with respect to the Lane-Fox patents has *really* much to do with their resolve? One can quite understand that such an uncertainty would be gladly seized upon as an excuse for an endeavour to make the parent company disgorge the concession money obtained from its numerous offspring. Whatever may be the cause, we do not see that any harm will ensue should some of the subsidiary companies cease to exist. In fact it is to be looked upon more as a matter of congratulation, as it had evidently been attempted to extend the Brush system beyond the demands for it; and when this system has found its fair level, and a few straggling companies, promoted for working other methods of little or no use, have followed in the wake of these subsidiaries, then we shall find considerable improvement in the prospects of those which are left.

It is difficult to see that any advantage is to be gained by attacking the parent company. Concessions were obtained by the directors of the "offshoot" companies presumably with their eyes open, and the shareholders also have only themselves to blame if they find they are losers over the late excitement in electric lighting matters. We would warn intending investors in electric light companies not to be again led away by any extravagant assertions of the daily press, or by the circulars of interested stockbrokers, but to be guided by the opinions of those competent to decide as to the merits or defects in any electric lighting system. The present nervous feeling existing as to the future of the electric light is not warranted, and the clearing away of the *fungi* of electric light companies will leave room for the healthy plants to thrive and increase.

INCANDESCENCE AND ARC LAMPS ON THE SAME CIRCUIT.

A short article in our last issue, sent to us by a correspondent, showed some of the disadvantages of combining the two systems of electric lighting on the same circuit. It was mentioned that one of the drawbacks was the fluctuation of the candle-power of the incandescence lamps with the change of resistance in the "arc." It is evident that arc lamps in which the carbons are arranged one above the other must all in a greater or less degree partake of this variation. There must be many instances in which such a combined system would be advantageous could the faults mentioned by our correspondent be avoided.

It would be interesting to know if the writer of the article referred to had ever tried arc lamps other than those of the above-mentioned type. The Rapieff arc lamp and the Jablochkoff candle should give very good results in conjunction with incandescence lamps, as in both the length of the arc is practically invariable, and therefore variation of resistance should be less noticeable than when the carbons are arranged point to point. The "Sun" lamp, of which the Rapieff system was the forerunner should also give equally good results. These systems therefore, at the moment, appear to be the best adapted for a combined method of working arc and incandescence lamps. The matter of arranging the circuits as described by our correspondent appears to us to present the greatest difficulty, and although, as before said, there are probably many places in which the combination is desirable, it does not seem at present that the two can be used together very harmoniously; it is wisest, therefore, to work each system independently of the other, and not risk a failure at a time when it is of paramount importance that all installations of the electric light should be pronounced successful.

The Cost of the Electric Light.—We read that in the York railway station, which for upwards of twelve months has been illuminated by means of the electric light, the use of gas has been resumed. It is said that the great extra cost of the electric light, as compared with gas, has induced the directors to make the change. We also notice that the town of Gainsborough (Lincoln) invited tenders for the supply of the necessary lighting for one year, with the following result:—Brush Midland Electric Light Company, £700, the Gainsborough Gas Company, £470, which was accepted.

DANGER FROM EXPOSED ELECTRIC LIGHT WIRES.

The recent death of a workman in America, who came to an untimely end by receiving the current from a large Brush machine, has been the cause of many sensational paragraphs and absurd statements in the daily press. We have alluded over and over again to the danger to human life involved in the manipulation of the Brush system, or indeed of any other system in which a large number of arc lamps in series are employed on a single circuit; and we have also touched upon the matter of fire risks attached to electric lighting, concluding that absolute safety from fire may be secured if proper precautions are taken. Whatever danger there may be from fire, injury, or death, attached to the use of the electric light, is now in a fair way of being grossly misrepresented. We learn that Mr. Edison is said to have confided to the reporter of a New York paper his opinion that such accidents would continue to increase with the multiplication of wires carrying powerful currents, till some dreadful accident occurred to arouse public indignation and compel the placing of all such wires underground. In case of fire particularly, the breaking of a great number of wires, which would be thrown down in inextricable confusion by the fall of a roof, might have serious results. Another gentleman, Mr. Park Benjamin, a well-known scientific man, has called attention in New York to the fact that a stream of water from a hose-nozzle, striking a broken arc-light wire, might easily serve to conduct the current through the body of the fireman who held the hose, with fatal consequences; while the cutting of such a wire with an axe, particularly if the handle of the axe were wet, might have a like effect.

The latest contribution towards giving the general public an idea of the horrors to be anticipated in the employment of electricity appeared in the columns of the *Times* of the 13th inst., under the signature of "A. I. C. E." This writer says:—"It is no secret that more than one theatrical manager has in contemplation, or has already decided, to employ the electric light in the coming Christmas pantomimes or extravaganzas as a personal ornament for their hobgoblins and fairies. This can only be done by means of some form of accumulator carried by, or attached to, the individual, and whether the star light is to form an ornament for the head, or to glisten at the end of a wand, the constant danger is patent. There is no need to be an electrician to understand this. A grave responsibility will be incurred by those managers who permit it—a still graver one by those who force it on their *employés*."

Returning to Mr. Edison and the breakage of a number of wires, we should imagine that such a casualty would have the effect of stopping the electric current altogether, and persons in charge of dynamo-electric machines would immediately know what to do. Mr. Park Benjamin cannot seriously mean that a stream of water striking *broken* arc-light wires could effect the serious results he anticipates. If the broken wires were sticking up in the air all the current produced by the machine would have vanished with the broken circuit, and a water column from a hose-nozzle would not be the means of reproducing it. If the wires were in connection with the earth then it is hardly to be expected that the current would prefer to travel along a water column. From the tone of A. I. C. E. one would imagine that the theatrical managers had taken him into their confidence, so exactly does he presume to know how their ideas are to be carried out. It would be an interesting sight to see the fairies and hobgoblins in a pantomime dancing about with accumulators attached to, or carried by, them, each cell weighing 60 or 80 lbs. Seriously speaking no one can pretend to say that the danger to persons or edifices is not far greater in the case of gas than with the electric current. Mr. Edison of course naturally prefers a low tension current, as his system is based upon it; Mr. Park Benjamin draws upon his imagination for something which will never occur in reality, and A. I. C. E. has doubtless his reasons for writing as he does concerning the electric light, but those reasons are not the result of experience. That there is danger attached to the employment of electricity we admit ıave always given it due prominence, but we cannot that the danger in almost every case is not sufficiently f ordinary caution is used.

THE WINDING-UP OF ELECTRIC LIGHT COMPANIES.

Before Mr. Justice Chitty's Court, Roll's Yard, three petitions were on Saturday last on the list for presentation in regard to the winding-up of the following Electric Light and Power Companies:—

The Brush Midland Electric Light and Power Company, on petition of R. J. Wigram;

The Birmingham and Warwickshire Brush Electric Light and Power Company, on petition of A. C. Sprange; and

The Devon and Cornwall Brush Electric Light and Power Company, on petition of H. Whorlow.

All three being opposed petitions were, on their being called, adjourned for a fortnight.

In the case of the Devon and Cornwall Electric Light Company, Mr. Waller said that this was a case in which the petition was really doing harm. It was a very large company, and its business was being seriously interfered with by the fact of the petition having been presented. He would ask that the petition should come on for hearing at a very early period—less than a fortnight. They wanted, too, their affidavits as soon as possible. The other side had, in fact, written to them that they should not hurry themselves with their evidence. If that were so, the case could not come on for some weeks.

Mr. Justice Chitty said that he could not allow the petition put down on the list an undue proportion of the time of the Court.

Mr. Waller read the letter alluded to:

Dear Sirs,—You shall have copies of the affidavits directly they are ready. Some will be sworn to-day or to-morrow. As the petition will be opposed, you are aware that it cannot be reached for some time. I shall be obliged if you will let me inspect the minute-book.

Mr. Justice Chitty said it was simply the statutory affidavits they wanted.

Mr. Waller said that it was, and he further considered that the procedure on the other side was demurrable.

Mr. Justice Chitty asked whether they were going to stake their case on the demurrer?

Mr. Waller said he should like to consider that.

Mr. Whitehorne, for the petitioner, objected to the proposal, but he would meet the company by suggesting Friday.

Mr. Waller said that gave them no time to answer it.

On the suggestion of Mr. Justice Chitty it was ultimately decided that copies of their affidavits should be handed to the defendants by midday on Thursday, the 16th, and on this understanding the petition stood adjourned.

VISION BY THE LIGHT OF THE ELECTRIC SPARK.

By W. LECONTE STEVENS.*

(Read before the American Association for the Advancement of Science.)

In previous papers the phenomena of optic divergence have been discussed, and also various peculiarities of vision under controllable physiological conditions. Among them was stereoscopy from a pair of perfectly similar figures, produced by so varying these in relative position that the retinal images of them were dissimilar. A geometric explanation of this was given, in which it was assumed that freedom of motion was allowed the eyes; but with the reservation that such motion is not necessary in obtaining the perception of binocular relief from stereographs constructed in the ordinary way, and that it was probably necessary only to the completeness of the perception in the present case when the dissimilarity of retinal images was very considerable.

In continuing this investigation the electric spark has been employed as a means of illuminating the pair of pictures. These were viewed with the aid of a reflecting stereoscope, already described as a device to indicate the value of the optic angle, positive or negative, that results from any possible relation between the visual lines of a pair of eyes. Vision may thus be made normal or abnormal at will. The

* An abstract of this interesting paper was given in our Notes columns, September 9th.

use of the spark in the study of binocular vision is no novelty; but it seems not to have been employed hitherto in studying abnormal vision with the visual lines divergent, or the peculiar mode of stereoscopy recently devised.

The apparatus employed was a large induction coil, belonging to the physical cabinet of Columbia College, the use of which was kindly granted by Professor O. N. Rood. In the secondary circuit a Leyden jar was interposed, and by means of a pair of lenses the light was separately converged upon each of the pair of pictures, strongly illuminating them momentarily in the dark room. Each picture was kept upon the pivoted arm of the stereoscope at a fixed distance from the oblique mirror that reflected its light into the eye of the observer. The sum of the incident and reflected rays from each to the receiving eye was, as nearly as possible, 25 centimetres.

The stereograph first employed was one of the moon, the same one formerly used with this instrument in vision by continuous light. By varying the arrangement of the cards the visual effect of binocular combination of images could be made that of either a convex surface, or concave surface, or an indistinct but flat surface. The observer placed himself with closed eyes in proper position before the stereoscope while the manipulator of the apparatus arranged the cards. He was then requested to interpret the combined retinal image produced by illuminating the cards with a single spark, not knowing previously whether to expect convexity, concavity, or flatness in the combined picture, and the interval of illumination being too brief for any possible play of the eyes.

In conducting these experiments I was so fortunate as to secure the co-operation of Mr. W. W. Share, Assistant Professor of Physics in Columbia College, who soon acquired more than usual skill in the control of his eyes. Each of us acted successively as observer and as manipulator of the apparatus, the work being distributed through a number of days for the purpose of avoiding fatigue at any one sitting. When the relation between the visual lines was such as to imply no unusual muscular strain, each of us found it possible to interpret the binocular retinal image correctly by the light of a single spark. Many other stereographs were substituted in succession for that of the moon, and with similar results. Some of these consisted of heavy black lines on a white ground, others of white lines on a black ground; in some cases one picture belonged to one of these classes and its mate to the other. At the suggestion of Professor Rood a pair were constructed, one of which consisted of green lines on a red ground, the other of red lines on a green ground. In this case of complementary colours it was a little more difficult to attain a perfectly clear perception by a single spark, but when there was any uncertainty another spark, after an interval of a second of time, was usually sufficient to resolve the doubt. These pictures were arranged to give stereoscopic relief, but the nature of this, whether direct or inverse, was what the observer had to determine.

Upon each arm of the stereoscope was now placed a vertical frame, pivoted centrally over a divided horizontal circle (fig. 1), so that the plane of the card that was fitted into it could be made to assume any desired angle (ϕ) with the direction of the arm. A pair of cards on which were similar series of concentric circles were then introduced, the arms being arranged for parallel vision, and the frames directly across them. The binocular resultant was, of course, a circular flat plane vertically across the combined line of sight. The manipulator then turned each frame on its pivot through an angle, whose nature, whether positive or negative, was unknown to the observer, and then passed a spark. For values of this angle less than 30° or 40°, the first spark was usually sufficient to enable the observer to determine whether the binocular resultant, due to opposite obliquity of projection upon the two concave retinas, was itself convex or concave. This was tried successively and independently by Professor Rood, Mr. Share, and the writer, with uniform results, the only difficulty consisting in the previous attainment of proper adjustment for the position of the head, and in adaptation of the ciliary muscles. For larger values of the angle between card and visual line, the degree of dissimilarity between the two retinal images sometimes caused a little confusion, but a few sparks, not in quick succession, were enough to clear all doubts. The diameter of the largest circle being 8 centimetres, and the sum of the incident and reflected rays from its centre to the eye of the observer being 25 centimetres, it becomes possible to calculate the maximum difference horizontally between the two retinal images. Let m and m' (fig. 1) be the points of incidence for rays from

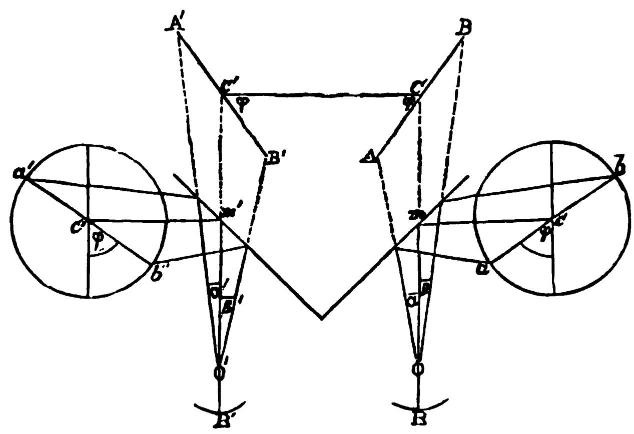


Fig. 1.

the centres c and c', of the circles whose horizontal diameters are ab and $a'b'$, the cards having been revolved each on a vertical axis through the angle ϕ. Then to the eyes whose nodal points are o and o', the pictures appear by reflection at AB and A′B′, the visual lines oc and $o'c'$ being parallel and perpendicular to cc^1. But if directed to A and A^1 or B and B′, the visual lines become convergent to an extent measured by the difference of the angles α and α' or β and β'. The values of α and α' can be expressed in terms of the variable ϕ and the known quantities Ac and co, and we are thus enabled to find for what value of ϕ the difference $\alpha - \alpha'$, becomes a maximum. For the value just assigned to Ac and oc, this condition is attained when $\phi = 52° \ 25'$. By ordinary methods in trigonometry two sides and the included angle of each triangle being known, α and α' are then determined, and their difference found, which in the present case becomes 1° 25′ 37″. Assuming an average value, 15·75 milimetres for the distance from nodal point, o, to retina, R, the linear horizontal displacement on the retina corresponding to 1° 25′ 37″ is a trifle over ·39 milimetres, or more than 80 times the diameter corresponding to what has been estimated to be the *minimum visible*. For angles even smaller than 52° 25′ both Mr. Share and myself found it possible to detect double images at the margins of the binocular picture; this, however, did not prevent the perception of the particular kind of relief, whether concavity or convexity, which the arrangement necessitated. In trying the experiment by continuous light many persons have at first been confused, but a few moments of play of the eyes were enough to produce clear perceptions, and the form of the binocular image thenceforth remained distinct even when the gaze was kept as nearly rigid as possible. Unless there has been special training in biocular vision the duplication of these marginal images is rarely perceived at all.

On the other hand, to find the smallest retinal displacement through which change of form in the binocular image can be perceived in this manner, I have substituted series of circles in which the maximum diameter was only 4 centimetres, keeping the distance unchanged. The plane binocular image became noticeably concave for a rotation of each through only 1°. By calculation the angular retinal displacement is here found to be only 47″, an amount so small that under the most favourable circumstances no double image could be perceived with the acutest vision thus far tested. These experiments therefore tend to confirm the conclusion reached by Helmholtz,* in opposition to many other physiologists, that neither play of the eyes nor the perception of double images is indispensable to the attainment of binocular relief, however important these elements may sometimes be in confirming our visual judgments, whether conscious or unconscious. They are exceedingly convenient for the purpose of explaining binocular vision, but so limited an explanation can never cover all the facts.

* "Optique Physiologique," p. 1,007 *et seq.*

In 1864 Professor C. F. Himes described a pair of pictures which he had devised to illustrate the variation in apparent size of the moon when viewed successively at the horizon and the zenith. Within two equal circles, A and A′ (fig. 2), are placed smaller circles,

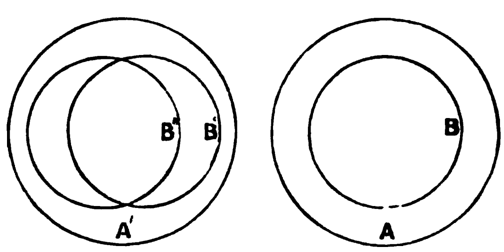


Fig. 2.

B, B′ and B″, the latter equal to each other. A and B are concentric, while the centres of B′ and B″ are on opposite sides of that of A′ and aligned with that of A. On combining the two pictures binocularly, A and A′ at once unite; B and B′ when united form a small circle whose plane is nearer, B and B″ one whose plane is farther than that of A and A′, assuming the union to be by diminished convergence of visual lines. The circle BB″ appears as much larger than BB′ as its distance is judged to be greater, despite the fact that the small circles are all of equal size. On the theory of double images, when BB′ is regarded, the circle B″ remains uncombined while AA′ should be seen double; the comparison of the nearer and more remote combinations being attained by regarding them successively. But in fact the appearance of the three circles, each at its proper distance, is instantaneous and simultaneous, not successive. If the observer's eyes are well trained the circle AA′ may be detected as double while the others are seen single. If the gaze be very rigidly fixed upon the centre of the combined circle AA′, the others are separated, three small circles are seen, but all apparent variation in distance is lost. This stereograph has been examined under the light of the electric spark by both Mr. Share and myself, the results being entirely analogous to those obtained with continuous light. Each circle was appropriately marked and the cards adjusted by the manipulator in such manner that the observer could have no previous knowledge to aid him in determining which combined circle ought to appear nearest. A single spark was usually sufficient to show each in its appropriate place. The circle B has the same effect on B′ and B″ as if it were simultaneously combined with both of them. This apparent combination of one line with two other lines at the same time was noticed by Professor W. B. Rogers in 1856 and further discussed by Helmholtz in 1867, but its bearing on the theory of binocular perspective has not received sufficient attention. It not only shows the insufficiency of the theory upheld by Brücke and Brewster, but also seems to indicate that, if there be any intuitive power of distinguishing between heteronymous and homonymous double images, this power must be understood to extend to cases in which a single line belongs to both kinds of double image at the same time. If we admit intuition at all in this connection we must further grant that a distinction can thus be made instantly between these opposite kinds of images, even when they are so minute that the unaided eyes cannot separate them through an act of conscious judgment; and that this is habitually done by thousands who throughout life fail to suspect even the existence of such duplication in any part of the field of view. If there is any perception of double images, even when the interval between the components is wide, it is by an act of special attention. Many of our judgments, not only in vision but in the performance of other bodily functions, are instantaneous and unconscious; but probably we shall never be able to put an exact dividing line between those due to the experience of the individual and those that spring from tendencies transmitted by the race. We learn to see, just as we learn to walk or talk in infancy, by oft-repeated efforts which form a succession of experiences. If passive seeing be a result of mere inheritance, then active looking is superadded as a result of training. The empirical theory, if sufficient to explain all known facts of vision, can leave no room for intuition, and its resources must be exhausted before any resort to intuition can be deemed necessary.

To test the illusions of abnormal vision by the light of the electric spark, a series of experiments has been made in which the optic angle was varied from 3° of divergence to 50° of convergence of visual lines. The graduated reflecting stereoscope was employed, the mode of experiment being the same as that described in a former paper, the manipulator of the apparatus keeping the observer's record of estimates. Mr. Share and myself relieved each other by turns, taking care to avoid fatigue of the muscles of the eyes, each remaining ignorant of his own record until the entire series of experiments was completed. After the arms of the stereoscope had been arranged to necessitate a particular value of the optic angle the observer opened his eyes, and, by the light of a slow succession of sparks, adjusted them to secure binocular vision of the stereograph of the moon, each picture of which was kept in a fixed position on the arm that carried it. The observer's judgment of the distance and diameter of the combined image was then recorded. Eight estimates for each of thirteen values of the optic angle were made in irregular succession by each observer, the experiments being distributed through two weeks. On examination of the results attained, they were found not to differ materially from those published in a former paper by myself, as secured with continuous light. The limits of error were much wider, as might be expected, showing that any single judgment under such abnormal conditions has very little value; but that, even when there is little opportunity for play of the eyes, the effect of muscular strain on the internal rectus and ciliary muscles is to modify the unconscious interpretation of the retinal image, making the picture look much smaller and nearer, but not necessarily at the intersection of visual lines. Mr. Share's judgments of distance and size were almost uniformly a little less than my own. In cases of optic divergence it was more difficult to secure the proper adjustment of visual lines than in those of convergence. Distinct vision was not attainable for divergence of more than —3°, though with slight indistinctness I found it possible to attain the perception of binocular relief for values as high as —7°. As a limit, therefore, —3° was selected, and this was attained by both observers, through voluntary control of the oculo-motor muscles. Since divergence of visual lines is never necessary in ordinary vision, such adaptation of the eyes if these be normal and not specially trained, requires usually two external points of fixation, and time becomes an element of more importance than when the co-ordination of muscular actions is such as habit has made easy.

THEORY APPLIED BY M. G. CABANELLAS TO THE RECENT EXPERIMENTS MADE BY M. MARCEL DEPREZ ON THE TRANSMISSION OF POWER FROM MIESBACH TO MUNICH.

M. Cabanellas, who has given much consideration to the questions of production and distribution of energy by electricity, and who is the author of a system of automatic working of such a problem, has just communicated to the "Académie des Sciences" of Paris the following theory: "In the transmission of mechanical energy by means of two identical dynamo-electric machines, the ratio of the speeds does not express the value of the return; the return is equal to the product of the ratio of the speeds into the ratio of the fields."

Those who have had experience with dynamo-electric machines have remarked that for a given number of revolutions, per unit of time, of the generating machine the maximum work is not obtained from the receiving machine when this is allowed to go at half the speed of the generating machine; but for a large number of types of machines, the receiving machine should go at two-thirds the speed of the generator to obtain the maximum mechanical work. This fact, however, is in contradiction with a theory

which is found in several scientific works, a theory which admits, explicitly or implicitly, the equality of the fields of the generator and receiver. But it must be granted by every one that from Lenz's law there follows the necessary reaction between the field and the moving current in each machine. The theory of M. Cabanellas takes exact account of all experimental results; his example shows how great this reaction may become with high speeds. M. Cabanellas' communication is, moreover, of great interest on account of the general method of reforming the electric elements, which he applies to the particular case of the experiments of M. Marcel Deprez as to speeds, differences of potential, and current observed at Munich by the engineer who carried out the following experiments in accordance with the instructions of M. Marcel Deprez.* Now that very exact instruments for measuring current and difference of potential are obtainable, the value observed by the easy method of M. Cabanellas for the total work given electrically to the generator has every reason for being much more exact than the value of the work obtained by interposing a transmission dynamometer between the mechanical source of power and the generating dynamo, since at a speed of 2,200 revolutions per minute the error introduced in the traction pull, and thence in the work of one revolution, is multiplied 36 times in the determination of work per second. In this method, M. Cabanellas has profited greatly by his former experiment on the increase of internal resistance of machines when running.

"In a series of studies on electrical machines communicated to the 'Académie des Sciences,' I have analysed the theoretical reasons which differentiate the reflex magnetic and electric elements of a machine, according as this machine is worked mechanically to create electric currents, or is worked electrically to produce mechanical work. But No. 15 du Tome XCV. des *Comptes Rendus* (Oct. 9th, 1882) has, on page 633, a note from M. Marcel Deprez, the conclusions of which prove to me that in the interest of science and its applications, it is indispensable to call attention to the results of the experiments of which I have spoken in a manner sufficiently concise for the figures to be followed. M. Marcel Deprez gives the results of an interesting experiment on the transmission of power to a great distance, which he has made from Miesbach to Munich (57 kilometres of overhead telegraph line). According to the note, the receiving Gramme machine developed half a horse-power, measured on a brake at 1,500 revolutions per minute, an identical Gramme generator at Miesbach running at 2,200 revolutions. M. Marcel Deprez concludes 'That subtracting the passive resistances of every kind, the ratio of the work reproduced at Munich, to the work expended at Miesbach, was as $\frac{1500}{2200}$ = more than 60 per cent.' It was a departure from the above-quoted theory that caused M. Marcel Deprez in the preceding assertion to make an error which is very far from negligible, since I will show *that from the results of this experiment, the return instead of being about 60 per cent. was about 20 per cent.*; that is to say, about one-third as much as the author of this experiment imagined. The above-mentioned notes besides the speeds of the machines and the work reproduced, give only the resistances (*in repose*) of each of the two machines (470 ohms), and the total resistance (line-wire and return) of the telegraph circuit (950 ohms). There would not be in this the elements necessary for a numerical estimation, but I find the following series of figures in a recent publication which relates to the experiment at Munich. Bulletin de la Cie. Internationale des Téléphones: Power transmitted ½ horse-power, resistance of each machine 460 ohms, resistance of line 1,000 ohms, speed of generator 2,100 revolutions, speed of receiver 1,400 revolutions, difference of potential between the terminals of the generator 2,400 volts, and between the terminals of the receiver 1,600 volts, current 0·5 ampères. It will be seen that the two sources of information present in what they have in common an agreement sufficient to permit both to be taken as the base of an approximate calculation. It is reasonable to take without selection the figures of the most complete source which can be applied, although they are a little different from those of the experiment noted by M. Deprez. Let i = current, E, the electromotive force of the generator, e, that of the receiver, r, the resistance of the generator *when working*, ρ, that of the receiver, R, that of the line, ϵ, the difference of potential at the terminals of the generator, ϵ_1, the difference of potential at the terminals of the receiver, t, the mechanical work reproduced per second (kilogramme-metre), t^1, the useless work of the receiver through rubbing of the brushes and resistance of the air, g, the acceleration of gravity. Neglecting at first the work done uselessly, we have:—

$$\epsilon_1 i = gt + i^2\rho \therefore \rho = \frac{\epsilon_1 i - gt}{i^2} = \frac{1{,}600 \quad 0{\cdot}5 - 10 \times 37{\cdot}5}{0{\cdot}5^2} =$$

1,700 ohms, and

$$e = \epsilon_1 - i\rho = 1{,}600 - 0{\cdot}5 \times 1{,}700 = \frac{gt}{i} = 750 \text{ volts.}$$

But the resistance of the machine in repose is 460 ohms, and therefore the increase for 1,400 revolutions is 1,700 — 460 = 1,240 ohms. The increase for 2,100 turns will be $\frac{1{,}240 \times 2{,}100}{1{,}400}$, and hence for the generator, $r = 460 + 1860$ $= 2{,}320$ ohms, and $\text{E} = \epsilon + ri = 2{,}400 + 2{,}320 \times 0{\cdot}5 =$ 3,560 volts, and therefore the return is $\frac{ei}{\text{E}i}$ or $\frac{e}{\text{E}} = \frac{750}{3{,}560}$ = 21·06 per cent., admitting that the current is not less at the receiver than at the generator, which would again lower the return. As verification,

$$i = \frac{\text{E} - e}{r + \text{R} + \rho} = \frac{3{,}560 - 750}{2{,}320 + 1{,}000 + 1{,}700} = 0{\cdot}55 \text{ ampères,}$$

which represents a loss of $\frac{5}{100}$ ampère = 1-11th of the current, in a total length of wire of more than 100 kilometres. The positive and negative tensions vary gradually, from a difference of 1,200 to 800 volts, with the potential of the earth. If it is wished to take account of the work, t^1, reproduced uselessly in the receiver, the formula becomes

$$\epsilon_1 i = gt + gt^1 + i^2\rho t^1,\ \rho t^1 = \frac{\epsilon_1 i - g\,(t + t^1)}{i^2},\ et^1 = \epsilon_1 -$$

$$i\rho t^1 - \frac{gt^1}{i}, \text{ and since } \rho t^1 = \rho_0 - \frac{gt^1}{i^2} \therefore et^1 = \epsilon_1 - i\rho_0 = e_0,$$

which should be *a priori*. The useless work, t^1, is easy to measure dynamically, and even electrically, by a method which I have communicated, and which has been inserted in the *Comptes Rendus*. In the absence of direct measurements, we may estimate this useless consumption at 1-10th of the mechanical power reproduced by the receiver, *i.e.*, at 3·75 kilogramme-metres per second. The above formula gives us for

$t = 37{\cdot}5$ and $t^1 = 3{\cdot}75$, $\rho = 1{,}550$ ohms, $e = 750$ volts, without any change, increase for 1,400 turns = 1,080, $r =$

$$470 + \frac{1{,}080 \times 2{,}100}{1{,}400} = 2{,}090 \text{ ohms, } \text{E} = 2{,}400 + 2{,}090 \times$$

$$0{\cdot}5 = 3{,}445 \text{ volts, } \frac{e}{\text{E}} = \frac{750}{3{,}445} = 21{\cdot}77 \text{ per cent.}$$

"Using the figures of M. Deprez's note for inert resistances, it would be

$$i = \frac{3{,}445 - 750}{1{,}550 + 950 + 2{,}090} = 0{\cdot}58 \text{ ampères.}$$

All our conclusions stand. If in the numerator of i we take account of the difference of potential lost through derivation on the line, we find 0·51 ampères. We have judged it interesting to pass through all the details of the reconstruction of the electric elements, for we might have at once applied the formula—

$$\text{Return} = \frac{gt}{\epsilon i + \frac{\text{N}}{n}\Big[\epsilon_1 i - g\,(t + t^1)\Big] - a\,i\,\frac{\text{N} - n}{n}},$$

which applies if the line is perfectly insulated. N, n, are the speeds of the generator and receiver, a is the resistance of the machine in repose at the strength of current, i. But the formula—

$$\text{Return} = \frac{gt}{\epsilon\text{I} + \frac{\text{N}}{\text{M}}\Big[\epsilon_{1_\text{I}}\text{I} - g\,(t_\text{I} + t^1_\text{I})\Big] - a_1\text{I}^2\,\frac{\text{N} - \text{M}}{\text{M}}}$$

in which $\epsilon_1\text{I}$ is the difference of potential between the termi-

* M. Cabanellas has since acquired proof of the authenticity of these figures.

nals of the machine, worked at a speed, M, by a current, I, the work got out by the brake being t_{I}, and the useless work t^1_{I}, a_I being the resistance at rest under the strength of current I. The value of the current I at the generator being greater than i, the value of the current at the receiver approximating in this case where the line is imperfectly insulated, the formula—

$$\text{Return} = \frac{gt}{\epsilon I + I^2\left[\frac{N}{n}\left(\frac{\epsilon_1}{i} - g\left(\frac{t + t^1}{i^2}\right) - a\,\frac{N - n}{n}\right]}$$

may be employed. With the preceding approximate figures a calculation would give I = 0·65, which would reduce the return to less than 15 per cent.

"The kind of calculation which I have just made shows how useful and practical is the consideration of the increase of internal resistance of machines whilst working; also with what ease it allows a great error to be rectified and of finding the return which a measure of the power expended at Miesbach will give, a measurement which is particularly easy and exact if, as has been remarked, the generator is driven by a separate gas-engine. In fact, when M. Deprez admits that the return is equal to the ratio of the speeds, he implicitly admits the equality of the magnetic fields of the generator and receiver, whereas, through the reflex actions of which I have spoken (electric current in movement inducing magnetism) the generating field was more intense than the magnetic field which the same current would develop with the armature in repose or turning with an open circuit, and the field of the receiver was less intense than this field not influenced, so that according to the figures given, the field of the receiver in this experiment would be three times less intense than the magnetic field of the generator.

"(Signed) G. CABANELLAS."

[This communication has been kindly sent to us by Mr. W. Cross, who received it himself direct from the Author. —EDS. ELEC. REV.]

PROCEEDINGS OF SOCIETIES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this society was held on Thursday, November 9th, Lieut.-Col. WEBBER, R.E., president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of proposed new members read, the secretary read a list of donations to the library of the society; he also announced that the *diplome d'honneur* which had been awarded to the Society by the Council of the recent Electrical Exhibition at Paris had been duly received.

The Secretary then read a short paper by Col. FRANK BOLTON (hon. secretary) on "Some Further Historical Notes on the Electric Light," bringing the subject up to the 30th September, 1882. The author stated that owing to the favourable reception which his first paper, read before the society in May, 1879, had met with, he had been induced to continue the subject so as to bring it up to date. The conditions in 1879 were different from what they were now, the subject of the electric light was then new. Since 1879 the number of patent specifications, bearing on the subject and published, were considerably greater than those issued previous to that year. The number of electric light patents taken out since the date of the author's last paper exceeded 550. Although, considering the great importance of the subject, it might be thought that the Commissioners of Patents should have undertaken the work of classifying the patents, yet the necessity of this has failed to strike them. Owing to the immense amount of work which a complete classification would have involved, the author only offers the new paper as a supplement to the first one. He referred to the great assistance he had derived from the valuable collection of electrical patents presented to the society by the Commissioners of Patents. The author suggested that if these electrical patents were classed under their various headings and bound up, or a classified index of them made, the labour of searching for any particular patent would be considerably lessened.

A paper was then read by Mr. W. H. PREECE, F.R.S., on "The Munich Electrical Exhibition of 1882." The author stated that although a number of invitations had been issued by the Council of the Exhibition, the Post-office had not been amongst the number of those who had received one. England was not properly represented at the Exhibition as a consequence. The display was national, and not international, and moreover, it was decidedly South German, the two principal firms of Siemens and Halske, and Felten and Guillaume, not being represented. Although the number of exhibits was very limited, being but 170, as against 1,700 at Paris, nevertheless the Exhibition was very interesting. Munich was the seat of all Steinheil's discoveries, the telegraph invented by him being brought out there in 1837; this telegraph was quite a practical instrument. The earth circuit was also discovered by Steinheil. The Exhibition was held in a glass building, similar to the Crystal Palace on a small scale. Its object was to bring before the German world the progress of telegraphy, and also to effect experiments, so as to determine accurately the relative merits of different forms of apparatus; its object also was to show how space could be illuminated, the result being highly artistic. The general arrangement of the building was very effective. At the main entrance was a fountain illuminated by the electric light. A striking contrast was obtained by two buildings, one representing the "Past" and the other the "Present." The former was an old hut, containing a table, stool, crucifix, &c., and lighted by an oil lamp; the "Present" was a library of the modern type, artistically fitted up and lighted by incandescence electric lamps. The most remarkable point of all in the Exhibition was the system of technical measurements, which had been arranged for testing the various exhibits. This was most complete, and consequently the certificates which would be given to the different exhibitors, and which would contain the results of the tests, would be of real value. It was decided not to grant medals, but simply the certificates. This arrangement the author considered very good, since it would check amateuring nonsense, for only scientific facts would be given, and those if properly made use of would greatly tend to check the progress of electric companies of a purely speculative nature.

In the nave was a copy of an old Norman church completely fitted with the usual ecclesiastical fittings and furniture, and with a lay figure of a priest; this building was lighted with the Crompton arc light. On the opposite side of the Exhibition was a theatre, lighted with Edison incandescence lamps hung in festoons, an arc light being in the centre; the arrangement by which the lights could be increased or diminished in brilliancy as desired was very satisfactory. The lighting of the picture gallery was decidedly bad. The general results of the lighting confirmed the author in his opinion that arc lights were only suitable for out-door, and incandescence lamps for in-door, illumination.

Amongst the machines for producing electricity there were several of the Holtz type, including that of Voss. A number of hand dynamo machines, costing from £15 upwards, were also shown. The accumulators of Planté were exhibited amongst others, and also a new accumulator invented by Schultze, of Strasbourg. The plates in this arrangement were coated with sulphide of lead and were immersed in sulphuric acid. Owing to the development of sulphuretted hydrogen, which took place at one of the plates when it was being charged, the use of this accumulator was very objectionable.

The display of cables, except that of Berthoud and Borel, was insignificant. A good exhibit of phosphor bronze wire was shown; this material is very durable, light, and strong, but its resistance is high. The firm of Montefiori Levi, however, have a specimen of No. 14½ B.W.G., whose conductivity is said to be equal to that of copper, whilst its breaking strain is equal to that of steel. Specimens of phosphor bronze are now under trial in England.

Amongst the historical apparatus was Soemmering's telegraph of 1829, Steinheil's telegraph of 1839, and the original Reis telephone invented in 1861.

The display of engines was very bad. An excepti[illegible], however, must be made as regards the exhibit of [illegible]

Ruston & Proctor, of Lincoln, which was extremely good. The author was much struck with the number of old inventions exhibited as new inventions under new names; for instance, the dynamo of Schaeffer was nothing more than that of Siemens, also the dynamo of Neumayer was as like the Edison apparatus as it could possibly be. Amongst batteries the Leclanché pure and simple could be seen under a new name.

Of the dynamo machines those shown by Schuckert were the best, and the report of the jury would, the author believed, tell very much in favour of this invention.

The transmission of force by water-power, distant 5 kilometres from the Exhibition, was shown in full operation. The power was obtained by a turbine driven by falls on the river Iser at a rate of 1,650 revolutions a minute; the current obtained lit up 11 arc lamps, 7 being in the palace and 4 in the grand place. An exhibition of the transmission of power was also shown by Marcel Deprez, the power being obtained from a gas-engine, and transmitted a distance of 34 miles from Munich. The wires were two in number, and were of $4\frac{1}{2}$ mm., with a resistance of 650 ohms. Two gramme machines were used, and the horse-power developed was half. The *loss* was not stated, but a calculation based on the known leakage which takes place over wires in England shows that over a length of 100 miles in damp weather a loss of 60 per cent. would take place, and of 3 per cent. in fine weather. It was an interesting fact, however, to see the transmission of power in actual operation.

In electric lamps there was nothing very new. Crompton's arc lamps were, in the author's estimation, the best; these were worked by Bürgin machines and were the only English exhibits of the kind in the building.

A convenient form of electric light for transport purposes was shown. This consisted of two trucks, on one of which was mounted the engine and dynamo, and on the other was the lamp, which was mounted on an adjustable post which could be lengthened or shortened by a lazy tongs movement. Incandescent lamps of the Edison and Swan type were shown under different names. Cruto's incandescent lamp was, however, a novelty as regards its manufacture; this lamp was formed of a platinum loop in the usual glass globe, on this loop carbon was deposited by keeping the same incandescent in an atmosphere of carburetted hydrogen. When the deposition was complete the platinum was deflagrated, leaving only a tube of carbon. This lamp is said to give 12 candle-power with $\frac{1}{2}$ ampère of current. If this is true it is a step in advance.

In telegraphs there was but little new. England has but little to be taught in this branch, even the Americans have to come to us for fast-speed apparatus. A railway Morse signalling system, for enabling any station on a line to be called up, has the merit of great ingenuity. Telephones were not conspicuous by improvements effected in them, in fact the exhibits rather tended to show how bad telephones could be made. An instrument with a 3 ft. disc, designed to give loud sounds and worked over a line of 30 miles, was shown working, but the result was a mere *fiasco*.

Some exhibitors showed some pretty adaptations of motion obtained by the movement of a telephonic diaphragm.

The effect of deafness produced by holding two telephones to the ears was strikingly exemplified.

Fire alarms, automatic signals, electric thermometers, and lightning conductors were freely exhibited. The free use of lightning protectors was a special feature in Germany, the very complete systems employed being in striking contrast to the state of affairs in England.

Railway signalling was largely represented, the most noticeable being the system adopted on the French Chemin de fer du Nord.

Clocks, bells, water-meters, were numerous, but did not present any remarkable points of great novelty.

In batteries there was nothing new or worthy of mention. Electroplating was well represented.

Medical applications of electricity were largely shown; in particular the effect of applying the poles of an electrical apparatus to various muscles of the face, as shown by a series of photographs, was very remarkable.

The most striking feature in the whole Exhibition was undoubtedly the arrangements for testing the apparatus exhibited. This was most complete and well arranged. One gallery in the Exhibition was set apart for a line of wires on insulators to act as a resistance for measuring strong currents; thermometers were set in the gallery, so that the temperature at any time could be seen, and thus any correction for a change in the resistance of the wire be made. The wires were of copper, and also of iron, and any resistance between one-tenth of an ohm and fifty ohms could be obtained. Various galvanometers were exhibited, graduated by the electrolytic method—a method which, in the author's opinion, is very satisfactory; two zinc plates in a solution of zinc sulphate are used for the electrolytic cell. In order to insure accuracy in the testing arrangements a great number of measurements are made by different experimenters and with different forms of instruments, so that the results obtained may be considered as absolutely reliable. Torsion galvanometers, quadrant electrometers, &c., were used for the purpose. No attempts were made to introduce novelties in the testing, but the best available methods were adopted. The results of the testing and the methods adopted have all been printed, and the author stated that complete copies of these would be presented to the library of the Society. The instruments used would measure all the necessary units, viz., of electromotive force, current, and resistance, but the results would be in Siemens' units, which was a mistake. The resistance of the lamps was measured by the substitution method, and as all measurements were made simultaneously and recorded simultaneously great accuracy and reliability would be obtained. The measurements of horse-power were made in German measure, which is the same as the French, the relative value compared with the English unit being as 736 to 746. The photometric standard was the English candle, and in cases where the comparisons were made with Carcel burners the ratio of the two would be as 9 or 10 to 1. The dynamometer for measuring horse-power was the Hefner von Alteneck. It had been determined to express the power expended in "watts," the watt, which was equivalent to the volt-ampère, was equal to $\frac{1}{746}$ of an English horse-power. As every effort had been made to obtain accuracy in all the measurements the results obtained would be most valuable.

It was arranged that the next Electrical Exhibition should be held at Vienna, and another at Berlin, in the year following. One advantage of these exhibitions was that it gave the small manufacturers a chance of coming forward with some degree of prominence, since large firms were not represented.

The great lesson to be learnt from the exhibitions was that technical work was more exact than philosophical, and that the latter have much to learn from the Society of Telegraph Engineers.

In the discussion which followed the reading of the paper, Mr. R. E. Crompton said that he did not agree with Mr. Preece's remarks with reference to the relative utility of arc and incandescence lamps; he thought that the two kinds were both suitable for indoor lighting, but that gas was best for outdoor illumination. As regards Cruto's incandescence lamp, experiment proved that deposited carbon was more efficient than natural carbon; he did not think, however, that the deflagration of the platinum wire in the lamp would prove an economical arrangement. The Schuckert machine he considered to be very good, though practically it was an infringement of the Gramme patent.

Mr. Lorraine said that in the Berthoud-Borel cable paraffine wax is not now used, but linseed oil which had undergone a peculiar treatment. The automatic manufacture of the cable was very remarkable, and it is an interesting fact that the machine requires scarcely any attention.

Professor Forbes referred to the Gentillé Glossograph as being an interesting exhibit. This instrument consisted of a number of springs which were placed in the mouth, and which made contacts when speech was being uttered. These contacts made five lines on a strip of paper, and from these lines it was possible to decipher what were the words spoken. He referred to the remarkably effective way in which the Edison light in the theatre could be turned up or down. The number of graduations of brilliancy being twelve. The locomotive electric lamp, which was fitted on the engines of a local railway, was wonderfully effective and most remarkably steady. He quite endorsed Mr. Preece's statements as to the excellent way in which the testing

arrangements were carried out. As regards the transmission of power question, it was important that the relative sizes of the transmitting and receiving dynamo should be considered. This had not hitherto been done. He considered that Marcel Deprez's experiments were greatly open to criticism.

Mr. A. SIEMENS pointed out that the raising and lowering of incandescent lamps was in full action at the Savoy Theatre.

After a few words in reply from Mr. PREECE the meeting adjourned.

PHYSICAL SOCIETY.—NOVEMBER 11th.

Prof. CLIFTON, President, in the Chair.

PROFESSOR ROWLAND, of Baltimore, exhibited a number of his new concave gratings for giving a diffraction spectrum. He explained the theory of their action. Gratings can be ruled on any surface of the lines, are at a proper distance apart, and of the proper form. The best surface, however, is a cylindrical or spherical one. The gratings are solid slabs of polished speculum metal, ruled with lines equidistant by a special machine of Professor ROWLAND'S invention. An account of this machine will be published shortly. The number of lines per inch varied in the specimens shown from 5,000 to 42,000, but higher numbers can be engraved by the cutting diamond. One great advantage of their use is that the relative wave-lengths can be measured by the micrometer with great accuracy. The author has designed an ingenious mechanical arrangement for keeping the photographic plates in focus. In this way photographs of great distinctness can be obtained. Professor ROWLAND exhibited some ten inches long, which showed the E line doubled, and the large B group very clearly. Lines are divided by this method which have never been divided before; and the work of photographing takes a mere fraction of the time formerly required. A photographic plate, sensitive throughout its length, is got by means of a mixture of eocene, iodised collodion, and bromised collodion. Professor ROWLAND and Captain Abney, R.E., are at present engaged in preparing a new map of the whole spectrum, with a focus of 18 feet. In reply to Mr. Hilgar, F.R.A.S., he stated that if the metal is the true speculum metal used by Lord Rosse, it would stand the effects of climate, he thought; but if too much copper were put in it might not. In reply to Mr. Warren de la Rue, he said that 42,000 was the largest number of lines he had yet required to engrave on the metal.

Professor GUTHRIE read a letter from Captain Abney pointing out Professor ROWLAND'S plates gave clearer spectra than any others; they were free from "ghosts," caused by periodicity in the ruling; and speculum metal had no particular absorption.

Professor DEWAR, F.R.S., observed that Professor Liveing and he had been engaged for three years past in preparing a map of the ultra-violet spectrum, which would soon be published. He considered the concave gratings to make a new departure in the subject, and that they would have greatly facilitated the preparation of his map.

Mr. W. BROWN then read a paper on the "Conservation of Energy and Central Forces." He showed that the doctrine of the conservation of energy necessarily involved central forces, and could not be proved unless on the assumption of a system of central forces. This involved the hypothesis of Boscovich, that matter consists of a collection of centres of force, and the author criticised the objections of Clerk Maxwell, Tait, and others to Boscovich's theory. The paper will appear in the Transactions of the Society.

Professor S. P. THOMPSON read some "Historical Notes on Physics," in which he showed that the voltaic arc between carbon points was produced by a Mr. Etienne Gaspar Robertson (whose name indicates a Scotch origin) at Paris, in 1802. This reference is found in the *Journal de Paris* for that year. Laboratory note-books at the Royal Institution, however, are said to show that Davy experimented with the arc quite as early. The experiment usually attributed to Franklin of exhausting air from a vessel of water "off the boil," and causing it to boil afresh, is found in Boyle's "New Experiments Touching the Spring of the Air." Professor THOMPSON also exhibited an early Reis telephone, made by Philipp Reis in 1861, at Frankfort, and designed to transmit speech. It was modelled on the human ear, one form of transmitter being a rudely carved wooden ear, with a tympan having a platinum wire behind, hard pressed against a platinum-tipped adjustable spring. Professor THOMPSON showed by various proofs that words were actually sent by that and similar apparatus.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

LEWIS'S PATENT SELF-BINDING INSULATOR.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I think no practical telegraph engineer will feel inclined to question your opinion on the merits of this insulator. It appears to be so very simple, and I should think, so inexpensive, that it must commend itself to every man who has had any experience of the old kind of binding.

In saying, in your article on the above invention in your last issue, that although the old system of binding is "not perfect it cannot be said to be inefficient," you appear to have altogether forgotten the article you wrote on Capanema's Insulator in the Review of the 16th September last, in which the disadvantages arising from the use of binding wire are forcibly pointed out. In saying that the present system of binding only costs ½d. per insulator, I think you should have stated that it costs that sum *every time* the line-wire is bound to the porcelain. Therefore, as an insulator will, especially near large towns, last out a dozen wires, it becomes plain that the first cost is not, as you very fairly put it, everything to be considered in placing a value upon the kind of insulator in question.

I should be glad if Mr. Lewis, or the manufacturers of his insulator, would advertise their address in your next.

Yours truly,

R. T.

London, *November 13th*, 1882.

[Our correspondent will find Mr. Lewis's address in our present issue.—EDS. ELEC. REV.]

FERRANTI *v.* EDISON.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Allow me to ask you for an impartial judgment between two systems of electric lighting, viz., that of Edison and that of Ferranti. Which of the two is the better and more to be relied upon? An answer to this question will greatly oblige. Awaiting your esteemed advice,

I am, yours, &c.,

Hamburg. PAUL MERKEL,
Telegraph Engineer and Electrician.

[In answer to our correspondent we can only say that the Edison system has long since passed the experimental stage, and is now successful and reliable. We cannot give any further particulars regarding the Ferranti method beyond what has already appeared in our columns, as it has not yet been made public.—EDS. ELEC. REV.]

ELECTRICAL TRICYCLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I have read with some surprise the reply of Profs. Ayrton and Perry to Mr. Reckenzaun's letter, which simply contained a courteous inquiry as to the details of their electric tricycle, and evidently was based upon purely scientific principles.

I trust, therefore, that you will permit me to state, through the medium of your valuable paper, that as an old pupil of Mr. Reckenzaun's I feel bound to say a word in his favour: that he is an excellent draughtsman, a competent teacher, an engineer in the highest sense of the expression, and a man of the strictest integrity, I do know; and I do not for a moment believe him capable of the conduct which Messrs. Ayrton and Perry were but too wise to "half conceal."

I know several Whitworth scholars, and successful men who took honours at South Kensington, and who, like myself, owe their success to the excellent tuition of Mr. Reckenzaun.

I think, Sirs, that it is an established fact, that directly a man is successful he becomes a criminal in the eyes of those who would like to be too; nevertheless it seems a great pity that the moral tone of scientific discussion can be lowered to the extent that it must be when scientific men like Messrs. Ayrton and Perry descend to reply to a courteous inquiry by a personal and gratuitous insult.

I am, Sirs, yours very faithfully,
FREDERICK WALKER.
Chief Engineer, Basted Paper Works, Sevenoaks, Kent.
November 13th, 1882.

SUGGESTIONS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Kindly permit an old friend of the ELECTRICAL REVIEW to offer you the following remarks.

Your columns are full of news concerning electric light and dynamo machines, every week's number offers a vast deal of information on these subjects, yet I should be inclined, like poor Oliver Twist after he had eaten the supper allotted by the dietary, to ask for more. In Vols. VIII. and IX. you favoured your readers with very lucid and detailed descriptions of the telegraphic apparatus in use in the British Postal Telegraph Department. Would not submarine telegraphy deserve a similar attention? The latest improvements in the syphon recorder, the beautiful key of Saunders and others, which we noticed among the exhibits of Messrs. Clark, Muirhead & Co., at the Paris Electrical Exhibition, in general, the instrumental arrangements of cable stations, the methods of working long submarine cables, are subjects well worthy of notice. The discussion between Messrs. Varley and Willoughby Smith (in 1879) has thrown a good deal of light on the matter, yet I should say that the student wants a good deal more of it. It might be as well to reprint Mr. Varley's excellent lecture delivered at the Royal Institution in 1867. With regard to the duplex system on cables we have very little information, with the exception of a paper of Dr. Muirhead's in the ELECTRICAL REVIEW, Vol. VII., and a similar one in *Journal Télégraphique* 1881, but those treat the matter rather from a historical point of view. According to Mr. Preece (inaugural address, *Journal Soc. Tel. Eng.* 1880) a great step forward in this direction has been made by Mr. Harwood, of the Eastern Telegraph Company, but with the exception of an incomplete specification, I could find no record of it. The *fac-simile* copies of Mr. Stearn's recorder slips, with which you presented your readers in Vol. VII., p. 163, are decidedly very interesting, but a lucid description of the duplex arrangement would be of far greater value.

Hoping that you will be kind enough to take some notice of my suggestions, I remain yours faithfully,

FOREIGN MEMBER S. T. E.

LIGHTNING PROTECTORS WANTED.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The following is taken from the daily press:—

SHEEP KILLED BY LIGHTNING.—During the thunderstorm on Wednesday, five sheep were killed on the farm of Cotland, Tinwald, belonging to Mr. Richardson. 300 yards of wire-fencing were torn away and the stobs smashed to pieces, and a large portion of the ground was torn up.

When several months ago a case similar to the above came under my notice, it occurred to me that all danger would be obviated by the fixing of earth-wires to the posts here and there, say, every tenth. As the cost would be trifling, perhaps the hint may be worthy of the consideration of farmers and wire-fencers.

I am, yours faithfully,
FAREHAM.

November 10th, 1882.

CHROMAS.—We are sorry that we accidentally overlooked your query. The chemical formula of the Fuller bichromate battery (which is now in use in the Post-office) is as follows:—

$$\left.\begin{array}{l} K_2Cr_2O_7 + 4H_2SO_4 = 2KCr2SO_4 + 4H_2O + 3O \\ 3Zn + 3H_2SO_4 = 3ZnSO_4 + 3H_2 \end{array}\right\} 3H_2O,$$

which means that the sulphuric acid in which the zinc is immersed, and the bichromate of potash in which the carbon plate is placed, become decomposed, so that sulphate of zinc and chrome alum are formed.

NOTICE TO STUDENTS.

(ELECTRICAL ENGINEERING.)

THE Editors of the ELECTRICAL REVIEW will be glad to receive correspondence from the students attending the various schools of electrical engineering in London, with the view of ascertaining the ideas of the pupils themselves on the methods of teaching adopted in these schools. We should particularly be glad to hear expressions of opinion from South Kensington, and the Cowper Street Schools of the City and Guilds of London Institute. Several of these centres of instruction have secured a large number of pupils, and as a thorough knowledge of electrical science is now more than ever necessary to the young electrical engineer, it will be interesting to know how far this is really derived from the courses of lectures and experiments to which the students are treated.

Do the Professors in these schools carefully consider their lectures before delivery, in order that they may be understood clearly by mental capacities of varying degree? Are experiments carried out under the direct supervision of the teacher, and are all the effects of the experiments explained to the student? Is sufficient attention paid to a proper understanding of electrical tables and formulæ by means of practical examples and explanations?

Are the classes too large to allow of any individual attention?

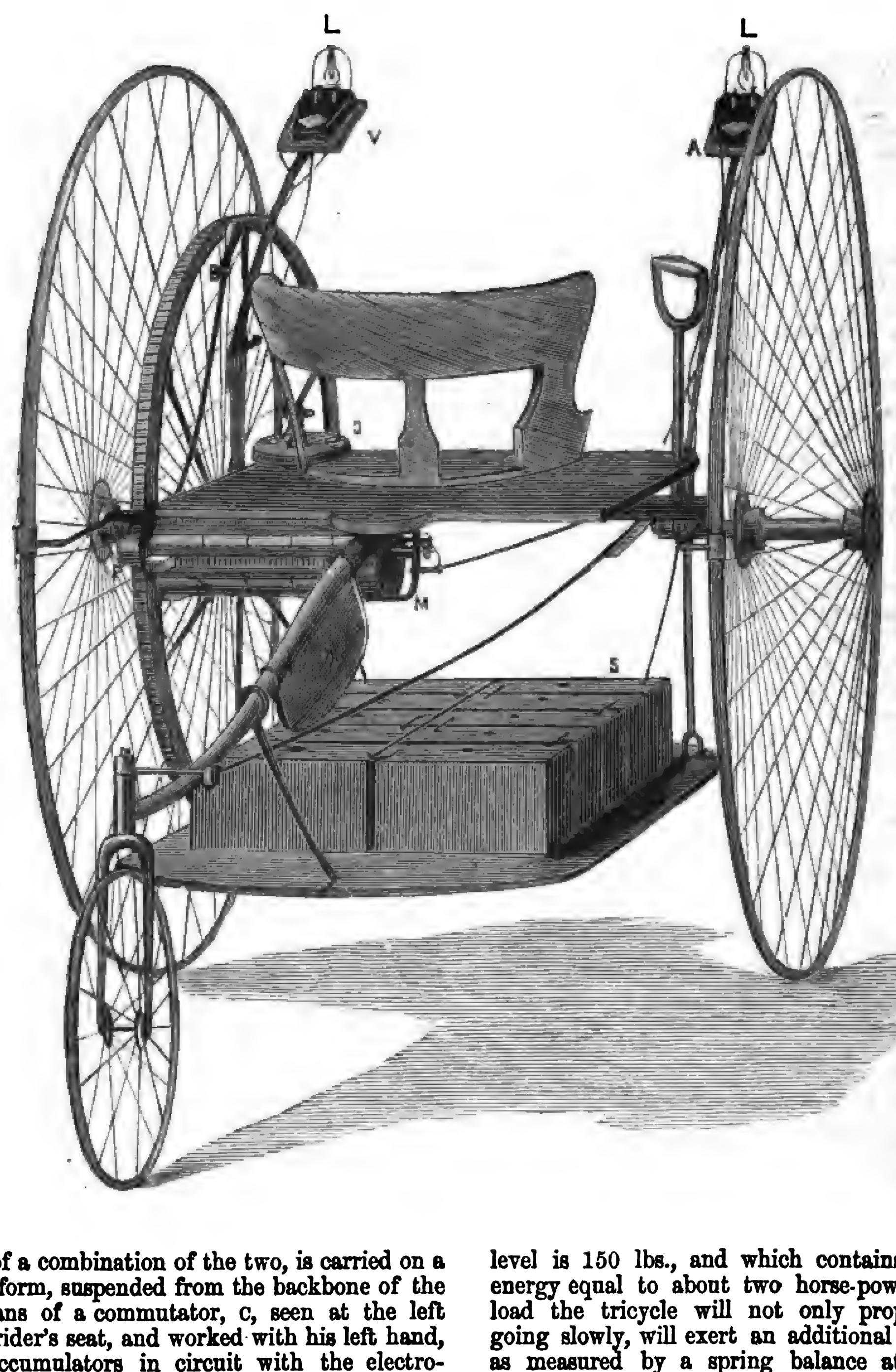
Are questions set at the end of each lecture for pupils to answer in writing during the week?

Do the Professors illustrate their teaching by experimental work performed in view of the entire class?

These, and similar questions which may occur to electrical students, we should be glad to have brief opinions upon for reasons which it is not necessary to state here in detail, but we may observe generally that it is in the interest of electrical science, and especially of the students thereof, that we desire to become possessed of the information for which we now ask.

THE ELECTRIC TRICYCLE.

THE accompanying illustration represents Professors Ayrton and Perry's tricycle, which is both electrically lighted and propelled by means of a secondary battery. M is their electro-motor, placed underneath the seat, and the spindle of which is geared with the driving wheel of the tricycle, 44 inches in diameter, by means of the pinion, P, and large toothed wheel. The pinion has 12 teeth on it, and the large toothed wheel 248, so that the motor turns about twenty times as fast as the tricycle wheel, or makes about 1,200 revolutions per minute when the tricycle is going at eight miles an hour. The secondary battery, S, which in the various runs has been composed of Faure cells, Sellon-Volckmar cells, and lastly, of a combination of the two, is carried on a small wooden platform, suspended from the backbone of the tricycle. By means of a commutator, C, seen at the left hand side of the rider's seat, and worked with his left hand, the number of accumulators in circuit with the electro-motor can be varied at will, and the speed of the tricycle altered accordingly. B, is the handle of the ordinary brake, which can be applied with the left hand immediately after turning off the current with the commutator, C. Since by means of this commutator the full power of the accumulators can only be turned on by passing through the intermediate powers, shocks to the tricycle and rider are not experienced at starting. A is one of Profs. Ayrton and Perry's ammeters, which measures at every moment the main current, and V is one of their voltmeters, the readings on which continuously show the electromotive force between the terminals of the motor, so that from the readings on the two instruments the rider can calculate at any moment the horse-power that is being expended in propelling the tricycle. L, L are two small incandescent lamps of about four candle-power each, and which are illuminated by a small current produced by two of the accumulators used also for the driving. The lamps are placed in the position shown, partly for the purpose of illuminating the track, and partly to light the ammeter and voltmeter.



The motor employed is one of their ordinary half horse-power patent motors, weighing 45 lbs., the smallest one that was completed when the tricycle was fitted up, but it is obvious that it is unnecessarily powerful for driving a tricycle. The smallest weight of accumulators that they have yet employed to produce a speed of six miles an hour on the level is 150 lbs., and which contains a store of electric energy equal to about two horse-power-hours. With this load the tricycle will not only propel itself, but, when going slowly, will exert an additional pull of about 33 lbs., as measured by a spring balance attached to its back, and held by a person attempting to resist the motion of the tricycle. With a somewhat larger weight of accumulators they have maintained a speed of eight miles an hour for a considerable time with a man of average weight riding. The tricycle is an ordinary one converted to this new use by taking off the treadles and chain gearing and replacing it with the electric arrangements seen in the figure, but we understand that the designers, encouraged by the success of the converted vehicle, are at present engaged on a tricycle specially suited for being electrically propelled, and in which, among other improvements over the present machine, will be so arranged

that not merely the rider but also the accumulators will be hung on springs. In their present form of electric tricycle the ordinary treadles to be worked by the feet are entirely absent, but in their first form the treadles were left on so that the feet and the electric propulsion could, when going up steep hills, be used to help one another, an advantage which may lead them, we are told, to introduce foot treadles as a supplement to the main electric driving power in their third and newest form of electric tricycle.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

ELECTRIC LIGHTING.—At the last meeting of the Leith Dock Commission, a letter from the Electric Carbon Storage and Manufacturing Company, offering to supply the electric light "more effectively and far cheaper than any of their competitors," was allowed to lie on the table.

THE Dudley Town Council assembled on Friday evening last week to consider the desirability of making application to the Board of Trade for a Provisional Order. After discussion, the streets and gas committee were given powers to oppose all applications by electric lighting companies for powers to supply the town with electricity.

IT was announced at the special meeting of the Pudsey Local Board last week that the Gülcher Company had replied to the communication addressed to them that they had no immediate intention of asking for a Provisional Order for the district. It was ultimately agreed, after some debate, that the board should do so.

ACCORDING to the Central News St. Petersburg correspondent, a concession has been granted to Mr. A. J. Rosseau, giving him the right to light all the imperial theatres with the electric light. This, it is added, will, it is thought, be an effectual protection against fire.

AT Windsor Castle preparations are being made to illumine a portion of the exterior of the palace with the electric light. From the generating machinery recently erected at the rear of the grand entrance in George IV.'s Tower, on the north terrace, wires have been carried over the library and Norman Gateway to the battlements of the flagstaff turret, on the Round Tower, from the summit of which the light will probably be displayed after the return of the Queen from Scotland.

ON Wednesday the Birkenhead Corporation specially gathered together for the purpose of considering a resolution "authorising an application to be made to the Board of Trade for a Licence or Provisional Order empowering the supply of electricity for public and private purposes within an area comprising the borough and the districts of Higher Bebington, Lower Bebington, Poulton-cum-Spital, Bromborough, Bidston, Prenton, Noctorum, and Upton, or such part or parts thereof as the Council shall determine."

THE Leek Special Electric Lighting Committee have asked the Gülcher Company for details of their proposed scheme for supplying Leek with light.

THE shipbuilding yards and sheds belonging to Messrs. Pearce Brothers, Dundee, have for about a fortnight been lighted by electricity. So successful has the installation, which consists of ten arc lamps, proved, that already additional arc and incandescent lamps have been requisitioned. A special Tangye engine for driving the dynamos was supplied by the Northern Electric Light Company, to whose careful management the success is largely due.

IN this question the Town Councillors of Perth have followed the lead of Birmingham, therefore no application will be made in the meantime by them for a Provisional Order. The papers relating to the subject have been remitted to the Police and Lighting Committees for careful examination.

ON Monday the Broughty Ferry Commissioners appointed a special committee to look after the electric lighting of their burgh.

SINCE the 10th October last the city of Surat has been lighted by electricity. The result has been pronounced a success.

THE guardians of Smethwick and of Willenhall, with the intention of supporting certain companies who have served notices upon them, will refrain from asking Provisional Orders.

AT the meeting of the Dundee Gas Commissioners this week, a gentleman in the course of a speech, said:—One word about the cost of the electric light as compared with gas. I had the pleasure of a conversation with Mr. Beckinsgale, manager of the Brush Electric Light Company of Scotland, who is presently here superintending the erection of the lamps in Commercial Street, and in the course of the conversation he stated that the cost of the electric light would not exceed the cost of gas. Being anxious to ascertain from him his data for this, I put a few questions to him, and after a careful calculation I found that the cost of lighting Commercial Street with five arc lamps, for the use of which the company charge 3½d. per hour per lamp, exclusive of the carbons, or say, 4½d. per hour per lamp inclusive of all charges, for one year, on an average burning ten hours per night, would be £342, while the cost of lighting by gas with 25 lamps, being the present number in the street, each lamp burning 5 cubic feet of gas per hour, would only amount to £79. Thus, allowing a good deal for the superiority of the electric light, it appears to me there is such a thing as buying gold too dear.

A SPECIAL MEETING of the Edinburgh Town Council was held on Tuesday to consider a report by the Lord Provost's Committee recommending the Council to apply for a Provisionl Order under the Electric Lighting Act, 1882. The Lord Provost explained that seven different companies were applying to Parliament for power to open their streets in order to light their houses and streets by means of electricity, and this Provisional Order was to enable them to protect themselves, and settle that no power over their streets should be given to any parties except the corporation. Dr. Russell pointed out that bit by bit, departments of the Government were looking after their municipal affairs, and here was the Board of Trade taking the control of their lighting. He hoped that there might be some joint scheme entered into by various corporations whereby this encroachment upon the management of their own affairs might be prevented. Bailie Anderson was glad to be able to say that the suggestion that had now been thrown out, that there should be combined action, was so far already adopted that he fully anticipated there would be united action by the different corporations. The matter was remitted to the Lord Provost's Committee with powers. We understand that the corporation will not supply the light, but arrange with one or more companies for so doing.

ELECTRIC LIGHTING AT BRIGHTON.—We learn that Mr. Magnus Volk is fitting up his works and house with incandescence electric lamps. The former will be lighted with Edison lamps of 8 candle-power, and the house with Edison 8-candle and Swan 16-candle lamps. The machine employed for this purpose is a Siemens' D^5, driven by a 2 horse-power nominal "Otto" gas-engine. Mr. Volk is also fitting up the warehouses and shop of Messrs. Wallis and Hacks with twenty Swan lamps of 20 candle-power, and ten of 10 candle-power each, a Siemens' D^7 machine, driven by a 3½ horse-power engine of the same kind as before mentioned, being used to produce the current. On the 2nd inst. he successfully lighted the King's Apartments in the Royal Pavilion with twenty-five Edison lamps of 8 candle-power, ten Swan lamps of 20 and eight of 10 candle-power respectively.

THE STANDARD FYFE-MAIN ARC LAMP.—About an acre of freehold ground has been taken at Brixton for the purpose of forming an electric lighting station by the company owning the Fyfe-Main Lamp. We understand that already orders and promises have been received, which will necessitate the development of about 100 horse-power. The

engines and boilers will be supplied by Messrs. Shanks & Son, of Arbroath, Scotland. The proprietors of the Brixton "Bon Marché" have given the Fyfe-Main Company instructions to supply them with 24 lamps of 3,000 candle-power each, to light up a portion of their extensive establishment for not less than one year. Like instructions have been received from Mr. Phillips, draper, to fit up two similar lamps outside his shop. Mr. Clark, a jeweller, has already had one of these lamps in operation for some little time, and we believe that the remarkable steadiness and brilliancy of this single light has been the cause of the demands which have rendered it necessary to organise a central station in Brixton. We shall be glad to hear that the company's operations are successful.

THE RIVER PLATE TELEPHONE AND ELECTRIC LIGHT COMPANY.—Mr. John Taylor, director of the River Plate Trust and Loan Agency Company, has joined the board of the River Plate Telephone and Electric Light Company.

MAXIM-WESTON ELECTRIC LIGHT COMPANY.—Mr. Hugh Watts, Leadenhall Street, London, has been appointed managing director of this company.

CHELSEA AND THE ELECTRIC LIGHT.—The surveyor of Chelsea in his Annual Report speaks of the electric light as follows :—"The question of adopting the 'electric light' is still under observation, and continues to receive my best consideration, and some few months since negotiations were opened with Messrs. Hammond & Co., but were eventually discontinued for various reasons. I have not been able to obtain any definite or reasonable terms for its adoption, and am therefore unable to recommend a trial of the system, which appears, however, to be making progress elsewhere. The various Bills promoted by the electric light companies this session were fully considered and reported upon, my suggestions being adopted by the vestry. The Sugg patent improved 80-candle gas burners and lanterns at Sloane Square continue to give very satisfactory results ; the extra annual cost as compared with the old system of lighting being £5 2s. 6d. per lamp.

THE ELECTRIC LIGHT AT WATERLOO AND NINE ELMS.—Provision is being made, and rapidly approaching completion, for the adoption of the electric light in the goods yard of the South-Western Railway Company at Nine Elms. The machinery is now complete, with the exception of the engines. The trial is an important one, as, if successful, other companies will follow suit. The Windsor platforms at Waterloo are also to be fitted with Edison's electric light burners, which will shortly be in active operation. The company have also had the board-room fitted with the light, as a test, and it seems likely that the company's gas bill will be considerably curtailed, more especially if the light proves a success upon the platforms and in the goods yards.—*South London Press.*

PROPOSED NEW TELEGRAPH LINE.—Mr. Vidal, an official in the Ottoman Telegraph service, has arrived in Egypt, and has asked permission of the Egyptian Government to establish telegraphic communication between Constantinople and Hedjaz by way of the Soudan.

UNDERGROUND AND OVERHEAD WIRES.—The New York *Herald* says :—The telegraph, telephone, and electric light companies, which are disfiguring the streets and avenues of nearly all our leading cities and towns, attempt to defend their outrageous action by declaring that the underground wire system is still a dangerous and doubtful experiment. Nearly all the telegraph wires in Germany are underground, and the experience of the companies and of the government there is all in favour of the plan which meets with so much opposition here. The city of Pittsburg, in Pennsylvania, has been making some experiments in this direction, and it is needless to say that they are entirely successful. This is a question which must be taken up by New York in the very near future. The unsightly poles, no matter to what ...y they belong, must come down, and the wires must ... underground.

THE NEW DANGER FROM LIGHTNING.—In the columns of a contemporary, a discussion on the dangers from lightning by the multiplication of over-house telephone lines is being conducted by Messrs. J. W. Gray and Sons, and Mr. Moseley, of Nunhead. The Messrs. Grays deny the truth of a statement that "in cities and towns where many wires traverse a small area, no better form of lightning protector need be wished for than they themselves constitute," and assert that "the smallness of the wires used for telephone purposes renders them useless for lightning conductors. Mr. Moseley, while declaring that the columns of a daily paper are unsuited for a technical discussion, pertinently remarks, "if the wires are useless to conduct lightning *through* a house, they must be far more useless to conduct it *to* a house," and adds, "the larger the number of wires within a given area the greater is the safety, whilst a single telegraph or telephone wire cannot conduct a dangerous quantity of lightning to a house." Mr. Moseley continues, "having many years ago become the fortunate possessor of the gigantic apparatus with which Andrew Cross used to harness the lightning in its greatest force, to make it prove all we know of the apparently fantastic changes of its force and form, I have as much first-hand knowledge of lightning's laws as any member of the Lightning-Rod Conference."

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting will take place on Thursday, the 23rd inst., at 8 p.m., when the following paper will be read :—"Notes on the Telegraphs used during the Operations of the Expeditionary Force in Egypt," by Lieut.-Col. C. E. Webber, R.E., president.

THE SOCIETY OF ARTS.—On Wednesday evening last, Dr. Siemens delivered his address to the members of this society. We regret that we were unable to find space for even a brief abstract in our columns this week, the more so as Dr. Siemens very courteously sent us proofs in advance. We shall, however, in our next issue, reproduce those portions of the address which will be of interest to our readers.

HONOURS.—The Royal Scottish Society of Arts Council have awarded a Keith medal, value 10 sovereigns, to Mr. Daniell William Kemp, for his "Description of an Electrical Barometer, a new Apparatus for ascertaining Atmospheric Pressure at any distance."

THE NEW LORD PROVOST OF EDINBURGH.—It will interest many of our readers to learn that Mr. George Harrison, the new Lord Provost of Edinburgh, first as secretary, and next as chairman of the Edinburgh Chamber of Commerce, was mainly instrumental in bringing about the transference of the telegraphic systems of the country from private companies to the government, and that the first use made of the wires on the transference was the despatch of a message of congratulation to him on the event. The reports he had prepared on the telegraphic systems were not only widely circulated in our own country, but translated and published by the Belgian government. The *Courant*, commenting on the appointment, says :—"It was not mere formal or fulsome flattery which dictated the eulogies of Mr. Harrison's proposer and seconder yesterday ; for his energies have not been confined to civic matters, but were greatly instrumental in giving the public the benefits of a cheaper and extended service of telegraphs. It would be a fitting sequence to this if Lord Provost Harrison, adding the weight of his new dignity to his personal endeavours, were to manage to induce the Post-office to institute a system of sixpenny telegrams."

CABLE REPAIRED.—The Indo-European Telegraph Company, Limited, announce that telegraphic communication by this company's line has been re-established, and messages are accepted as usual for transmission to India and the far East.

CANADIAN TELEGRAPHS.—The great North-Wes... graph Company propose laying a submarine cable in Superior under the charter of the company, to connect William, Manitoba, with Ontario. The telegraphic s... requires 600 miles of line, with a cable, and anothe...

along the Canada Pacific Railway, over the Rocky Mountains, together with the existing system in British Columbia. Telegraphic communication on Canadian soil and waters, from ocean to ocean, would thus be secured. The proposed line for the laying of the cable is from some point on the Indian Peninsula, north-west of Owen Sound, connecting with land-lines along Manitoulin islands, and small cable links to Sault Ste. Maria, thence by one cable through Lake Superior to Thunder Bay. The estimated cost of the cable is 400,000 dollars.

THE INTERNATIONAL TELEGRAPH CONFERENCE.—In our issue of October 21st we gave a full list of the names of the delegates of the various countries represented at the Conference held in Paris. Their labour is for the present terminated, and at the conclusion of their work they were addressed by M. Cochéry and by M. Kern, Swiss Minister, who is the senior member of the Diplomatic body, and also the Swiss representative in this Conference.

There were in all four questions with which the Conference was concerned. The first question related to the protection of telegraphs; the second was to lay down rules for vessels laying or repairing telegraphs; the third question dealt with the rights of telegraph companies; and the fourth question, which seems the most difficult of all, and was discussed after the others, concerned the tribunals before which offences against the International Code are to be brought and the punishments to be inflicted.

The chief articles agreed to are the following :—

The breakage of or damage done to a submarine cable, if caused intentionally or by culpable negligence, having the effect of stopping or clogging, altogether or partially, telegraphic communications, will be punishable, and costs and damages will be recoverable by civil action besides. Any owner of a cable who, in laying or repairing it, shall cause breakage or damage to another cable, must support the expenses rendered necessary by that breakage or damage. Vessels occupied in laying or repairing submarine cables must observe the rules or signals which are or shall be adopted by common consent of the high contracting Powers. When a vessel occupied in the repairing of a cable has made the said signals, other vessels which see or are in a position to see these signals are to retire from the spot or else to keep themselves at a distance of a naval mile from the scene of operations for fear of hindering them; and fishermen's nets are to be kept at the same distance. The ship engaged in repairing the telegraph is to be as speedy as possible in its operations, and any vessel holding off in answer to signals is to be granted a delay of twenty-four hours at the outside. From a buoy indicating either the position, derangement, or repair of a submarine cable, all boats and fishermen's nets must keep away at least a quarter of a nautical mile. In case the owner of a boat can prove that an anchor or a fishing net has been lost by him in his endeavour to avoid injury to a cable, the owner of the cable is to indemnify him; but in order to claim this indemnity the captain of the boat must address a *procès verbal*, supported by witnesses, to the proper authorities within twenty-four hours after his arrival in port. The authorities will give immediate notice to the consul of the nation to which the owner of the cable belongs. The competent tribunals to recognise infractions of this Convention are those of the country to which the offending vessel belongs; and prosecution for offences shall be conducted by the State or in its name. All evidence admissible in the ordinary tribunals of the country shall be admissible in these cases; and *procès verbaux* may be drawn up by officers commanding ships of war or ships specially commissioned for the purpose, whatever the nationality of the offending vessel, such *procès verbal* in each case being drawn up according to the usual forms, and in the language of the nation of the officer who draws it up. In any case of contravention of the regulations of the Convention, judgment is to be given as summarily as the laws and regulations allow.

These are the regulations adopted by the Conference. In addition, the various members pledge themselves to do their best to induce the Legislative Bodies of their respective countries to adopt these regulations and make them both international and domestic laws; and the members are also to inform each other of all laws passed in their own countries with reference to the objects of the Convention. Any State that has not yet joined the Convention shall be admitted on demand, this demand to be adressed to the French Republic, and by the French Republic to the other signatories. The Convention shall continue in force for a space of five years from a day agreed upon by the high contracting parties; and if, twelve months before the expiration of those five years, no one of the Powers shall have given notice of its intention to retire from the Convention, the Convention shall continue one year, and so on from year to year. If any Power renounce the Convention, the renunciation shall only that Power.

The Conference hopes that the Powers will agree at once on the signals to be used, both at the laying and at the repairing of a cable; and further that the various Governments shall indicate, by means of buoys placed at the side, the direction of submarine cables, and buoys of uniform type should always be used for the service.

NEW COMPANIES REGISTERED.

NORTH-EASTERN ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—Capital £100,000, in £5 shares. Objects: The ordinary business of an electric light and power company. Signatories (with 20 shares each): * Wm. Wilson, Roker, Durham; * S. Storey, East Beldon, Durham; * J. H. A. Culliford, * Thos. Wilson, * R. M. Hudson, Jun., * W. E. Irish (electrical engineer), and S. Alcock, of Sunderland. Directing qualification, 50 ordinary shares. The shareholders in general meeting will determine the remuneration of the board. Registered 9th inst., by Flint & Co., 49, Fleet Street.

KERNER BURGLAR PROTECTION COMPANY (LIMITED).—Capital £100,000, in £1 shares. Objects: To acquire and work the patented invention of Marion Harrison Kerner (No. 1195) for improvements in relation to electric circuits, and in apparatus for protection from burglars. Signatories (with one share each): T. Torrey, 19, Aurial Road, West Kensington; G. L. Audery, Cintra Park, Upper Norwood (electrician); J. B. Henck, Jun., 152, Brecknock Road, N. (electrician); W. L. Goodfellow, Hampstead (electrician); C. M. Turner, 12, Rockbourne Road, Forest Hill; G. Buckler, Catford. Registered 9th inst., by T. Torrey, 19, Aurial Road, S.W.

AUSTRALIAN AND NEW ZEALAND ELECTRIC COMPANY (LIMITED).—Capital £5,000, in £5 shares. Offices: 1 & 2, Chiswell Street, E.C. Objects: To acquire the right and interest of Lewis Abraham Tallerman in eight agreements with the Maxim-Weston Electric Light Company, Limited, for the use of their apparatus and systems of lighting in the colonies of Victoria, New South Wales, Tasmania, Queensland, New Zealand, and South and Western Australia. The purchase consideration is £1,200 in fully paid shares. The company will also repay £1,000 expended in connection with the said agreements, and £600 for machinery and apparatus agreed to be purchased. Signatories: * L. A. Tallerman, 1 & 2, Chiswell Street, 14 shares; * S. Hoffnung, 13, Basinghall Street; S. Sinclair, 13, Basinghall Street; * H. Nathan, 12, Copthall Court; P. M. Montague-Marsden, 8, Belsize Square; A. Hoffnung, 3 & 4 Great Winchester Street Buildings, 4 shares each; and E. J. Emanuel, 15, Austin Friars, 1 share. Directing qualification: £50 shares or stock. Registered 10th inst., by Lousada and Emanuel, 15, Austin Friars.

FRENCH METROPOLITAN AND GENERAL ELECTRIC COMPANY (LIMITED).—Capital £1,200,000, in £20 shares. Objects: The acquisition of patent rights, &c. in France appertaining to electricity and electromotive force and the working and development of the same, especially in the departments of Seine, Seine et Marne, and Seine et Oise. Signatories (with one share each): L. F. Brettingham, 26, Bloomsbury Square; G. Ridout, 79½, Gracechurch Street; E. H. Cadiot, 3, East India Avenue; H. B. Green, Manchester; A. W. Gay, 88, Bishopsgate Within; G. O. F. Wilkinson, 32a, Piccadilly; G. V. S. Sleeman, 6, Melor Place, Kensington. Directing qualification: Shares to the nominal value of £500. Remuneration: £3,000 per annum. Registered 10th inst., by Campbell, Reeves, and Hooper, 17, Warwick Street, Regent Street.

* The signatories to whose names an asterisk is prefixed are directors.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

ELECTRIC NEWS TELEGRAPH COMPANY (LIMITED).—The return of this company, made up to the 27th ult., was filed 3rd inst. The nominal capital is £150,000, in £5 shares. 7,805 shares have been issued, and £3 per share called up. The calls paid amount to £23,227 10s., leaving £187 10s. unpaid. Registered office, 4, Ludgate Circus.

DUPLEX ELECTRIC LIGHT, POWER AND STORAGE COMPANY (LIMITED).—The return of this company, made up to the

2nd ult., was filed on the 1st inst. The nominal capital is £100,000, in £1 shares. 30,394 shares have been taken up; and 12s. 6d. per share has been called. The calls paid amount to £17,004 4s. 6d., and unpaid to £1,992 0s. 6d. Registered office, 9, Soho Square.

CITY NOTES, REPORTS, MEETINGS, &c.

DEVON AND CORNWALL ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

Mr. W. H. Owen presided on Thursday at an extraordinary general meeting of the shareholders of the above-named company held at Cannon Street Hotel. There was a rather small attendance.

Mr. F. B. Lidstone, secretary, having read the notice convening the meeting,

The Chairman, having read a circular sent round to the proprietors, said: The questions then will be whether the company shall be wound-up, and the company reconstructed, or whether the company shall be continued to be carried on. I should like to give you some information as to what occurred at the commencement of the company. The first document placed in my hands the first time I was in London was the prospectus of the Great Western Electric Light and Power Company, in which was a paragraph saying, "This company has secured the concession . . . . for the exclusive right to the dynamo machines and arc lamp of the Brush system, together with a licence for the exclusive rights of use and sale of the Lane-Fox incandescent lamp;" and, further, that one of the most important branches of the business of the company would be granting sub-licences to local companies, giving them the monopoly of sale and the use in their districts of the valuable Brush and Lane-Fox apparatus. Now, gentlemen, I give the Great Western Company credit for acting *bonâ fide* in this matter, and being in ignorance of the fact that they had not the exclusive right as mentioned. That made one feel very comfortable, and did not suggest reasons for doubting that it was true. But from inquiries which the directors of this company have made, they learn as a matter of fact that the use of the Lane-Fox incandescent light has not proved so very valuable as to be worth one moment's consideration; and that there are many other lamps in the market of better value, that may or may not be so. The powers given to purchasers by the Electric Light Bill make the matter of still smaller moment, because they had a right to say which lamp they would use. I do not know that there is anything further as to the facts that I can give you now, but if any shareholder wishes to ask any questions, I shall be glad to give him any information in my power.

Mr. G. H. Terrell said he spoke as the mouth-piece of a constituency, representing nearly half the company, as they held 9,000 shares with £2 10s. subscribed. By the 14th clause of the agreement with the Great Western Company, he found that in the event of the Devon and Cornwall Company commencing to be wound-up it should return its concession to the Great Western, which would be virtually giving them 3,000 shares, representing £7,500. Therefore, in the face of that fact, and of others, he thought to permit themselves to be wound-up at that moment would be suicidal. There was no doubt in his mind that they had very little claim indeed against the Great Western, but that somebody was responsible to the company was manifest. They had subscribed their money for something which was of comparatively little value to them. If they looked at the Electrical Review for July 17th, 1881, they would find the merits of four lights compared, and the Lane-Fox amongst them. He submitted if one case were heard as a test that it would succeed. He proposed a committee of investigation to confer with the directors upon the state of the affairs of the company, and report to the future meeting; and that Mr. Henry Maudsley (a director), Lord Claud Hamilton, and Mr. Mortimer, a gentleman from the West of England, be the committee.

Mr. Fewings seconded the proposition, and explained that he had sent out his circular in ignorance of the fact that the clause alluded to was in the agreement with the company. He addressed the circular in the terms he had done because he gathered somewhat clearly from the circular sent out by the company that the board thought the business of this company could not be carried on.

The Chairman: That was by no means the intention of the language used; there is no intimation to that effect in the circular.

Mr. Fewings replied that he had not said that was the *real* meaning, but it was the inference he drew. He thought they should be very clearly advised as to their rights against the Great Western Company. How did it arise that there was such an unbusiness-like clause in their agreement. There was no such, he was informed, between the Anglo-American and the Great Western. If there were any persons responsible they should be brought forward.

Mr. Russell Evans said there was a similar clause in the agreement of the Anglo-American with the Great Western.

Mr. Fewings supported Mr. Terrell's motion.

In answer to a question,

The Chairman said that their first solicitor was at the same time solicitor to the Great Western Company.

Mr. Howard: A very irregular proceeding.

Mr. Walter Webb said he thought they should face the question at once, whether they were to wind-up or to go on. He did not like the idea of a committee. What did it mean?—a prolonging of this unfortunate matter, ultimately leading to liquidation. He wanted the meeting rather to consider whether they could not strengthen the hands of the directors, and go on with the objects for which the company was formed. It was most undesirable to weaken the hands of the directors by introducing a state of things which a committee would bring about. He felt his interests were safe in the hands of Mr. Maudsley. He thought they ought not to let it go to the world that they were parleying with those litigants who had taken proceedings. If they wound-up they lost all their Brush lights. He thought they would certainly be acting in an idiotic manner if they wound-up, and the appointment of a committee he felt was certainly a step in that direction. He had always deprecated the formation of sub-companies; still these companies were formed under the influence of a rush on the novelty. His idea, instead of a committee, would be that they should go to the Great Western and say, "You launched us; we are met by difficulties here and there; cannot you take us back, and give us shares in your company in lieu of those of the Devon and Cornwall?" If they talked of a committee of investigation he was sure the Great Western would not then entertain such a proposal as his. He urged the meeting to leave matters in the hands of the directors, or ask them to negotiate with the Great Western for the return of this company on suitable and equitable terms. He would propose, "That this meeting, having heard the statement of the directors made in accordance with a promise in their circular of 7th November, expresses its entire confidence in the board, and desires to strengthen its hands in continuing the business of the company, and opposing all hostile action against the company or the directors individually."

Mr. Shippey seconded, and the original motion by Terrell was withdrawn, notice not having been given of it.

Mr. Howard questioned whether, in the face of article 77, any resolution could be put or passed at that meeting. He certainly opposed a winding-up or any committee, for the company was now at a point when such a step might seriously injure it. He thought rather that they should ask themselves the question, "Do you think you have the business that will carry you on?" "Are you *likely* to succeed?" When the directors told them that they had not, or when he came to the conclusion that they had not, then was the time for them to do something.

Mr. Arthur Shippey remarked that he thought the district of this company was one of the best in the kingdom where business could be done. He thought they should repose confidence in the directors.

Lord Claud Hamilton said he intended by no means to support any committee, but to give that to the directors. He was also of opinion that it would be suicidal of them to attempt to wind-up the company. To place the thing in the hands of a committee would be to take all the power out of the hands of the board. He thought this was a storm in a tea-cup, and would soon be past, when confidence would be restored to the Brush system. This was a miserable attempt on the part of some Stock Exchange men to depreciate the whole of the Brush system. He happened to be a director of the parent Brush Company, who gave exclusive rights to use the Brush dynamo and arc lamp, and a "full" licence to use the Lane-Fox lamp. The parent company thought as they only gave a "full" licence to use the Lane-Fox they could charge nothing for it. What had been the result of that mistake?—they had not lost a single sixpence. There was no doubt that the Brush arc light had been a success in America, and why should they be afraid it would not succeed in England?

Mr. Henry Maudsley (a director) said he held 1,000 shares in that company. The conditions under which they had come before the shareholders that day was to get their co-operation and assistance. He was a director also, he must say, of the Great Western Electric Company (but had sent in his resignation, although it had not yet been accepted), and of the Anglo-American, and he believed the shareholders had confidence in his determined purpose and character, and he desired for an honest condition of things, and an honest desire to promote the interests of the company. He was sure the Anglo-American had acted in a suicidal way by charging such exorbitant prices for their patents. Their dynamos were now very much cheaper, and their shares were down from £60 to £19. They apparently forgot that in a grand system like the electric light they should make a small profit and quick returns to get it universally used. Under the circumstances they had damaged the whole blessed business. He had lost £10,000 himself in electric undertakings, and had sold shares £2 10s. paid, for 10s. and 3s. 6d. Did not they think the board had some reason for coming before them that day? He wished to tell them the whole truth, and nothing but the truth, and to do his duty fearlessly. Let them give the board their confidence if they liked, or censure them if they liked, they had *all* made a mistake.

Mr. Collins asked what business had been done or was in prospect that might aid them in expressing an opinion.

The Chairman gave a brief *résumé* of the operations of the company, which showed a total receipt, according to his figures, of £39 10s. Successful experimental installations had been made at one or two places—Penzance and Exeter amongst them, and very satisfactory opinions expressed.

Mr. Collins was sorry the answer was not more satisfactory. Would there be any good in their strengthening the hands of the directors? Did they really think there was a commercial success before them? He did not believe the light was any use in the tin mines; neither did he expect anything from "the winter coming on," for they had it already and no orders with it.

Mr. Webb's "expression of opinion" was then put to the meeting and carried; and the proceedings, which had lasted two hours, terminated.

YORKSHIRE BRUSH ELECTRIC LIGHT AND POWER COMPANY.

An extraordinary general meeting of the shareholders of the above company was held on Wednesday last, Mr. H. W. Lowe presiding. There was a large attendance.

The Chairman said: Ladies and Gentlemen, the meeting which we are holding, I need hardly tell you, is one of the greatest importance.

In fact, we have to decide upon a matter of no less moment than that of the continued existence of this company, or its immediate dissolution.

The recent action of one of our shareholders decided the board to convene this meeting at the earliest practicable date in order that you may hear a full explanation as to the affairs of the company, and also that you may have an opportunity of discussing whatever remarks might fall from us. I am sure I feel, when you have heard all we have to say upon this matter, and also the discussion that may arise, you will have dispelled from your minds entirely that bogey, if I may call it, with which one of your shareholders has been so perseveringly endeavouring to alarm you with. The first matter with which I have to do is to call attention to the circular of Mr. Whiteley, which, doubtless, you have all received. I may say that the greater portion consists of insinuations and accusations, which if they had been launched against an individual, instead of a company, would have placed him in a very dangerous position. It seems to me in these days, a man with some pretence of philanthropic motives can assail a company, make the gravest accusations, bring its credit down to the ground, and from fear of the consequences he would not have dared to take that course as to any individual in business. He states, in language which I am sure admits of no doubt as to its meaning in the first circular, that we held furtive meetings for the purpose of doing something or other which may be considered wrong—something to do with a red herring, I believe. Next he says that in some cases shareholders have been paid up. He goes on to say, "a desperate scramble exists as to who should be paid first." Then again, "It is grossly unfair that a privileged few should get their money back." Then "the substratum of the company is gone in the loss of the exclusive Lane-Fox licence. The directors are meeting each other, asking where the business is to come from." We denied these accusations and denied them most implicitly. He replies that what we say is absolutely untrue. I must remind you that all these expressions were intended to attach themselves to this company. In paragraph 9 he says, "Brought into the calm arena of the courts, let the directors deny, if they can, the allegations I make. If they can to the satisfaction of the court, no one would be better pleased than I would, and I should be happy to withdraw my petition." He must be a very happy man if he thinks that after having done all these things to the satisfaction of the court we should allow him to withdraw his petition. Again, "only 11,000 shares have been *boná fide* applied for by the public," and when we have denied this he says he adheres to his former statement and will prove it. I defy him to prove anything of the sort, anything but falsehood of his own statement. As to the number of shares, the directors did not proceed to allotment until 36,633 shares were duly applied for, and the money paid in to our bankers in the usual way on application, and on the allotment being made in due form the balance was paid in to our bankers, with the exception of some very few shares, alluded to at the last meeting. A few people apparently could not find the balance due, but that was a very infinitesimal quantity. In the sixth paragraph of the second circular he says that they have held meetings with the directors of some other of the incriminated companies. I am very happy to have this public opportunity of stating that we have never been, individually or collectively, or has any member of this board been present at any meeting of any such kind, nor has there been the slightest intercourse with any representative of any other company. I also deny most emphatically that we have had any meeting with the Hammond Company, or tried to get any concession from them of any kind. There has been no thought of the matter. The decision of that depends on this meeting entirely. Having, I hope, cleared from your minds any idea of having acted in a dishonourable manner, I want to come to the important question raised as to this exclusive licence to the Lane-Fox lamp. At the earliest meeting of the company we read over these two licences very, very carefully, and no one ever had the slightest idea that there was anything in them, but that they were ntended as exclusive licences granted to us. The language of the icence appeared to us, and still appears to be, direct and xclusive, and I must point out that we were not alone n this view, several other companies taking up the same osition. I suppose some of their shareholders at least examined he agreements which were open to them; and the directors of hese companies no doubt read their licences very carefully; but ot one word was heard of any doubt or question on this oint until Sir Charles Bright wrote to the ELECTRICAL REVIEW, on the rd November, and pointed out that there was a concurrent licence ranted to the British Electric Company. I can only say that if we ad had the word "full," instead of "exclusive," we should have sed the one word for the other, as being of identical meaning; we hould not have considered that there was any difference in the ading. I desire to make this explanation to show that as far as the irectors were concerned they believed completely that the Lane-Fox cence was an exclusive one granted to us according to the terms of e licence; but when the fact of this concurrent licence came to the owledge of the directors, our first thought was naturally how far this company damaged by that fact? I am sure all our desire was see what we could possibly do to guard against any effects that it ight have, and whether it was possible to set up any legal right ainst such companies as the Brush Electric or the Hammond for mpensation. I am frank to admit to you that so far as we knew is, and so far as we now know, we have not suffered one farthing of s or damage by the concurrent licence. The British Company have footing whatever in the County of Yorkshire, and even if they had e Lane-Fox lamp is now made by the Brush Company and sold to from the Hammond Company, making it very largely impossible t the concurrent licensees can produce any lamp superior or even al to it. Therefore I say in point of fact we have still an exclusive ht to the Lane-Fox lamp, inasmuch as ours is superior to any other. r consulting electrician, Mr. Phillips, is present here to-day, and as this is a matter with which he is quite familiar, I hope he will be able to tell us something in definite terms about this lamp. So far again as Mr. Whiteley's statement is concerned with the directors as to their meeting and asking each other where the business is to come from, I can state that our manager's reports continue to be most satisfactory. We are now just about to complete an installation at Middlesboro' of forty lights working upon the rental system. This, I feel sure from the promises received, will very soon be repeated. There is room there for more than we can do in electric lighting. Each of our undertakings now produces a very handsome profit to the company, as we have given up all idea of working for nothing, or of exhibitions, which all infant companies are obliged to follow up to some extent. If we cannot work at a profit we decline to work at all, for exhibition work means great expense, and it is a question now that electric lighting is better known, whether there is much good in it. We are now engaged in negotiations by tendering for an extensive amount of work. We do not expect to get all of it, but we expect at all events sufficient to give us plenty of work. Our expenses are kept down at a very small point; we have had no preliminary expenses; we began with a clear sheet, and the directors have been careful to weigh every single pound in order to reduce the expenditure, and then if the work turns out not to be sufficient for us to make a good dividend out of at the end of the year, we will at all events be in the position of not having wasted any of your money and having spent it in useless things. At present of course we have to oppose the enormous monopoly of the gas companies, and that takes time to move. One cannot expect that electric lighting can attain success by rapid strides. I can only repeat what I said before that the progress of the company so far has been satisfactory, and it has entailed no great expense. But now as to the question paramount. Is this company at the wish of a few discontented shareholders, and at the instigation of one, to be wound-up, and shall our concessions, which we have paid so much for, be cancelled, as they must be, and revert to the hands of those who sold them? What will be our position after the company is wound-up? The whole of the shares issued must come to a *pro rata* distribution of the assets of the company ("No, no!"). That is my assertion; you may contradict me afterwards if you like. The shares issued must come in for distribution, and if you add to this the enormous charges of liquidators and lawyers, and the usual expenses of winding-up, you may very plainly see that nothing but very bare assets will be left. I am a shareholder, having no interest whatever in promoters or vendors—a simple shareholder, as you yourselves are, and with no other interest except to get this company a success. It seems to me that if this company should be wound-up the result will be that no one will be benefited except the friends and nominees of Mr. Whiteley, for it is usual in these cases for the petitioner to get the order for the official liquidators—the whole business, in fact, becomes his from that moment. Mr. Whiteley describes himself as a surveyor; I venture to say he is also an auctioneer, and he is so accustomed to the "going, going, gone" of his trade, that he thinks he can knock down this company with his hammer. I hope we shall show him that we are by no means so easily knocked down as he imagines. He uses a little artfulness in asking you to be present by counsel at the hearing of the petition. That is that you may ease him of the expenses which he fears may fall upon him otherwise. I shall presently have the pleasure of submitting a resolution to you, but before doing so I shall ask Mr. Phillips to give you some practical explanations as to this lamp, which has been alluded to just now.

Mr. Phillips (engineer to the company) said he held a lamp which was the result of the latest improvement by the Brush Company in the lamps, which were really the result of the labours of Mr. Lane-Fox and his very valuable superintendent, Mr. Evans, and one or two others. The lamp they had now is as different as possible from the original one, as could be imagined. And the cost of the lamp was much diminished from the price, even ten weeks ago, and would be much cheaper later on. The lamp was, as they saw, as simple as could be seen. Mr. Phillips then entered into a technical description of the new lamp at some length (amidst murmurs of "We don't want this lecture"), and remarked that they might get a profit at selling them at 3s. or 4s., whereas they could not get such profit as they could now some time ago by selling lamps at 6s. or 8s., and this as the result of the labours of Mr. Lane-Fox and Mr. Evans; and he thought they had now got a lamp which was so simple that the ordinary servant could fix them. And which would enable them to produce that which was domestic and utilisable. Therefore if any one wanted 1,000 lamps, they did not have to charge them 10s. for each lamp; they could be sold now with a handsome profit at 4s. or 4s. 6d., and they could replace them easily, and get a high candle-power from them. If they wished to know the pulse of the country generally, he believed in Yorkshire, Durham, and Lancashire, they had a good field for business, apart from consideration of patents. The corporation of Leeds were preparing to spend £60,000 in electric lighting to begin with. They required that the company volunteering for the work should make an installation which should be perfect. If, at the end of the year, all went well, that contract for £60,000 was to be obtained, and if they got only 10 per cent. there was £6,000 profit. The Hammond Company were actually estimating in one or two places, getting plans of places, calculating, and so on, and the directors could send then an estimate for the work. If this company only got one-tenth part of the business of Yorkshire it would be more than the company could manage. A company in Sheffield he knew would like to spend £150,000 on electric lighting, and the company that inspired this Sheffield company with confidence would get it or part of it. If this company should get £50,000 of it, it will be worth the having. There was plenty of work there, he was sure, for a company of this kind. Having a lamp so efficient he was sure there was work there, which would give them business. They had before the Patent Office some improvements to make the machinery even more perfect. Therefore he might tell them that all the experiences in companies which may be different from others went towards the benefit of the companies generally.

A Shareholder: Is there one sound?

The Chairman: I should think I am within the mark if I say we have six. If you ask my own opinion I should think we have twelve. The resolution I have to propose to the meeting is "that this meeting hereby empowers the directors to carry on the business of the company, and oppose the opposition of the winding-up petition laid by Mr. Whiteley, and to take such steps as they deem necessary for the protection of the company's interests."

Mr. Bromham seconded the resolution. He expressed his regret that such charges were brought against gentlemen of high character in the city of London, who are exceedingly well known. If Mr. Whiteley had any charge to bring against the board, he thought the best course would be for him to call the attention of the directors to see if they were selling what did not belong to them, and to suggest a remedy for the error, if any. He believed they had business men on the board, and he was willing to leave the matter in their hands. He thought most of the shareholders took shares at that time with a view to their going up in value. He thought their action must be against the Hammond Company, if the mistake was really a substantial one.

Mr. Whiteley then opposed the resolution in a speech of considerable length. He thanked the chairman for his courtesy, although he had been at times facetious at his (Mr. Whiteley's). He had thrown down the gauntlet, and he must expect some knocks back (laughter). But he had not yet said that the misstatements were wilful. The language in his circular was plain and simple, and he was prepared to take the consequence if misinformed. He was informed that furtive meetings had been held by the board, but he was glad to hear the chairman say that was not the case. But that meetings had been held apart from the shareholders there seemed no doubt. He had no animosity against the directors. The company were in a pickle, and he thought he had taken the best course to get out of it. 36,633 shares were applied for before allotment, and were therefore allotted (A voice: "That won't help us"). He had gone on the information he had received, and he should try and disprove that. The chairman went round and round his remarks, but he agreed with him when he said the directors only *thought* they bought the exclusive right to use the Lane-Fox lamp. The chairman having admitted that, he thought he might sit down. A full and exclusive licence was about the same thing. The chairman said that no damage had resulted to the company from their not having an exclusive right to the lamp, but that was a very improper position to take up. The chairman having admitted that the exclusive right was a mistake, he thought he should have stopped there. They ought rather to ask what has been the gain. A great feature had been made of an improved lamp; so that £100,000 had been paid by this company for what was really an imperfect lamp. ("No, no.") Well, one that was capable of great improvement. A great feature had also been made of the Middlesborough lighting, which they were told was *now* nearly complete, although they heard it was in progress in September. The engineer had said they might throw their patent into the fire if they liked, for there was plenty of business; and for this they had paid £100,000! The gentleman who seconded the resolution had pushed his remarks too far; he (Mr. Whiteley) did not make any criminal charge against the board, nor accuse them of dishonourable conduct. What did the directors and the promoters promote this company for: simply for pure philanthropy? It seemed to him that that meeting was somewhat of a farce. They were supposed to have 61,000 shares on their register, of which the Hammond Company held 35,000. What was the use of their coming there and voting on the question? The resolution had been cut and dried, and they had no means of opposing it. But he came there as he had presented this petition, he thought it only right that he should come and defend his action. He had no sinister or ulterior motives, and his intentions were honest. In paragraphs two and eight lie the whole substance of their undertakings; paragraph eight being very naturally suggested by the doings of the Brush Company. This company were deprived of the monopoly of the Lane-Fox, and was it not possible for the Brush Company to go in and tender at a lower price than this company?

The Chairman: No; they cannot do that.

Mr. Whiteley said they had no more right to sell the Brush than the people walking in the streets at that time. He believed the Brush reserved to themselves the right to sell their own lamps ("No, no"). In the agreement they found that the shares should not be allotted unless £35,000 were *bonâ fide* subscribed by the public, which he did not believe was the case by a long way at the time of allotment. Out of their 61,633 shares on the register, they would find that the Hammond Company held 35,000; the Electric Works Company, 5,000; Mr. A. C. Barker, 2,500; Mrs. Barker, 2,500; Mr. P. C. Barker, 2,500. These, he suggested, were not *bonâ fide* public subscriptions, but were all friends or relations of Mr. Hammond. If he kept a shop, naturally he should do business with some of his relations if possible. A Mr. Bentley also held 2,500 shares, and he was, he believed, a subordinate of Mr. Hammond, or his company. So that the company only held 11,633 shares on the 26th September. Even if the Barker family were *bonâ fide* public subscriptions, that only left 21,633. He had not taken isolated action, for he had now 101 shareholders at his back; and he was not a small shareholder now. With reference to two names on the original prospectus as directors, he failed to find their qualification of 125 shares.

The Chairman: They never took up their position; you know that perfectly well.

Mr. Whiteley: I beg you will not contradict me, and throw the lie in my mouth. I did not know it perfectly well. If they had retired, we ought to have known it. He remarked in continuation, that they had been grossly misled, and if they were in fault they should go to those who misled them; but to the board, the shareholders must look. Mr. Hammond, it was stated, said at the statutory meeting, "with regard to the machine referred to, it was the joint production of Sir William Thomson and Mr. Ferranti, and it would be understood how very important a stride was likely to be made when it was said that the machine would for incandescent lighting accomplish something like five times as much as any machine at present in existence." If that was so, what had they paid their money for? The Brush was gone. They were not only crippled in their concessions, but they were also crippled for working capital, for only £23,000 belonged to them. He knew it was no use going to the vote on this question, but he asked for their moral support. He said "wind-up now, while you can get some something out of it. Do not go on with this crippled thing on crutches; it will go down sooner or later."

Mr. H. B. Seeley said he knew they could not succeed on the vote, but he was of opinion that that company had not been legally formed. The prospectus said the first issue was to be 200,000 shares. He ridiculed the idea of the articles of association only being on view in one office in London, when they appealed to the whole country. The directors could not legally float that company with a less number of shares than would give the company a fair chance of success. The company had been floated with about a quarter of what was spoken of in the prospectus. When he found that the company had been floated with 67,000 shares, instead of £100,000 as advertised, he wrote to the secretary for an explanation, which he got, but it seemingly involved a misrepresentation which the directors ought not to have allowed to go forth to the public. He thought there had been a breach of trust in this matter if they could show that at the closing of the lists they had not the minimum number of shares subscribed. All Yorkshire to be lighted with £23,000, and the profits to be divided over £123,000! He was much obliged to Mr. Whiteley, although he himself moved very early in the matter. The eleventh clause of the prospectus stated that the vendors would pay all the expenses of the formation of the company, but in the articles of association it was stated that the directors were empowered to pay the expenses. Why was that difference? He thought the difference there between the prospectus and the articles of association was vital.

Mr. Macallister, who said he was the holder of £1,000, said that a few days after he had paid his money he discovered that only £70,000 were subscribed. It was not reasonable nor proper to allot shares upon such an insufficient capital. It was stated as an inducement that application would be made in due course for a quotation on the Stock Exchange. That was a speculative inducement, because it represented it as a marketable commodity. He had consulted Mr. John Morris, of Messrs. Morris and Company, who said that it was too big a thing for a single shareholder to fight, though no doubt he would succeed. Unless there were other shareholders to join him, he would not advise him to fight it as a private individual. He had listened carefully to the arguments of the chairman, and it seemed to him that the whole question was admitted. They admitted that there was no exclusive right to the Lane-Fox. They said: We have not the Lane-Fox, but we have something else which is better. The question was, first—Had the Hammond Company swindled them? If so, what had the directors done to get their money back? When they found that there was no exclusive right, they should have had a meeting with the Hammond Company at once, and told them that they had induced them to issue a misleading prospectus. But they accepted the situation, and practically parted with £100,000. What valuable property had they got at all? If the directors were satisfied that the Hammond Company had not acted fairly, then that company had deceived them; if otherwise, then the directors had deceived the shareholders. He trusted that the meeting would demand fuller information about their relations with the Hammond Company before consenting to any course of action.

Rev. Mr. Stobart asked if it was the case that nothing had been paid for the Lane-Fox licence, and what actual capital the company had to work with.

Mr. Joseph said that the alleged paucity of capital seemed to have resulted from the lists having been so quickly closed, and he should like to ask the reason why they were so.

The Chairman said that Mr. Whiteley had made several allegations against the honourable character of the board. He said they had held furtive meetings; that, he (the chairman) denied in the most emphatic manner. As to the exclusive licence question, it had come on the board perfectly unawares. They never doubted that the Lane-Fox was as exclusive as the Brush. The first question when the concurrent licence came to light was, What damage had they suffered? They wrote to the Hammond Company, and on 27th October they got a reply, which stated that a copy of their letter had been sent to the Brush Company and promising fuller reply as soon as they were able to give one. Immediately after that came Mr. Whiteley's circulars and winding-up petition, and they at once ceased all further negotiations till they saw the result. But the Hammond Company had always behaved honourably to them, and he felt sure they would settle the matter to their full satisfaction. The Hammond Company had evidently no more knowledge of the concurrent licence than they themselves had. The wording of the prospectus had passed under their review, and was not objected to. Some companies used the word *full* and others the word *exclusive*, and they considered that it did not make the slightest difference. That Mr. Whiteley had said that £50,000 had gone to the vendors of shareholders money, and then again that it was the friends of the vendors who found the money. If one was true how could the other account be so? They had no means of inquiring the position of those who applied for shares, they might be friends of the vendors or they might not. He himself had not the slightest knowledge of any as friends of the vendors. It had been [illegible] said that it was quite clear the shareholders would be outvoted. [illegible] Well, he had asked Mr. Hammond to-day how he was going to act with regard to his vendors' shares. He replied that he was [illegible] going to exercise no voting power whatever with them (hear, hear), leaving the meeting free to decide one way or another. They wa[illegible]nted the meeting conducted in a straightforward way. It was no[illegible] a packed meeting; he did not recognise a single friend's face, a[illegible] and they only wanted them to decide on the merits of the case. If t[illegible] they had suffered damage from

that exclusive licence, they might depend upon it that they would do their utmost to bring that company to book. How far they might succeed would depend on the strength of their position. As to Middlesborough, he had stated that the works were on the point of completion, and at the previous meeting that they were in preparation. No time had been wasted, in spite of Mr. Whiteley's remarks upon the subject. He calculated, reckoning ten per cent. on the capital, that they would get a profit of 33 per cent. upon the working. The question of necessary capital rested with the directors. It was not to their advantage to have a large sum unemployed in work, simply lying at interest, as some companies had. They should be cautious at first. Electric lighting was a novelty; it had the gas monopoly to contend with, and Englishmen fought shy of a novelty. They had to see their neighbours taking to a thing before they took to it themselves. As to the expenses, the Articles of Association did empower the directors to pay them, but they did not think of anything of the kind. The whole of the preliminary expenses were paid by the vendors, which was what he meant in speaking of beginning with a clean sheet. Mr. Stobart asked whether they had paid anything for the Lane-Fox licence. Their position was the same as that of the Midland. One of the conditions with the Brush Company was that they should give to the Hammond Company the Brush dynamo to use, and in addition to that they gave them the licence to use the Lane-Fox lamp. Perhaps the conditions of the licence may serve to explain why they did so. They knew they could not sell it, since there was a concurrent licence. They therefore had kept within legal bounds by concealing that fact. They had concealed that fact from Mr. Hammond, for he had clearly sold the licence to them. Some shareholders might think that their money should be returned. That was a question of the fair dealing of the directors and the original meaning of the prospectus.

Mr. Maynard said that Sir Charles Bright's letter had taken him thoroughly by surprise. But it did not so much matter for they had not done a stroke of business as to the Lane-Fox, and with the improvements of incandescent lighting, it was openly said that the Lane-Fox was superseded. He distinctly denied the allegations in the circular of Mr. Whiteley as to furtive meeting and negotiations with other companies. He thought winding-up the company would be most disastrous, as he believed at present under their active, intelligent, and restless manager the business was in a surprisingly good condition.

Mr. Seeley asked how many shares were applied for when the lists were closed on 28th May.

The Chairman could not answer that question. If the company had been launched two days sooner their capital would have been applied for five times over. As it was many applications came to return money. The allotments were sent out by 1st June, after very numerous applications, though certainly very numerous withdrawals —which latter they need not have accepted if they had cared to allot at once, as was often customary.

Mr. Maynard said it was the greatest test of a company to keep open so long, so that any withdrawals might be made.

Mr. Seeley wanted to bring out how many *boná fide* applications had been received up to that date, exclusive of vendor's shares.

The Chairman said that would require the books of the company.

Mr. Seeley said the directors should have been prepared to answer such a vital question. Where, he might then ask, did the directors expect to get the money for the working of the company?

The Chairman said that they had ample capital as it was. They had an arrangement with the Hammond Company, by which the latter would do work, and they themselves should reap the benefit, if it was too large for them to do themselves. The company had a larger interest in their prosperity than any one else, and had everything to bind them to it. If they had to keep a staff large enough to work all their County of Yorkshire it would require a capital of three or four millions.

Mr. Stobart said that £100,000 had been paid to the Hammond Company and there was left £20,000 to go on with.

The Chairman said that was perfectly correct, or rather £23,000.

Mr. Stobart: Then in fact we are only a small branch of the Hammond Company?

The Chairman: That is simply our position. An idea had occurred to him that if the Hammond Company made a large sacrifice of their shares, cancelled a large portion of them, it would relieve their company of a great incubus. They should do all they could to work all the handles which their position enabled them to get hold of.

Mr. Seeley asked why they could not be wound-up and go on as a branch of the Hammond Company.

Mr. F. Ince, solicitor for the company, said, that having heard what had been said by the chairman and Mr. Maynard, they might surely leave the matter in the hands of the directors. As to the Lane-Fox, in all candour and honesty the concurrent licence should have been stated openly; but he did not think the British Electric, however, would affect them much, because that company had not the Brush machine. A licence for a particular gas-burner would not affect a patent for gas manufacture. It was a rather sentimental grievance at best. He would advise them to avoid liquidation; it paid the liquidators admirably, and the lawyers, but it would never pay the shareholders (laughter).

The seconder of the motion would suggest as a means of avoiding difficulty that Messrs. Whiteley, Macallister, with others, might be appointed as a committee to represent the shareholders and confer with the directors as to the best course for future arrangements of the company.

Mr. Whiteley could not agree to the suggestion. He did not see the good of a conference with the directors. Both had stated their opinions, and would not recede from them. He believed that they were an honourable body of men, but the shareholders' money was at stake, and the question was, how to pay for the mistake they had made? The directors had made a mistake, and simply asked them to trust them again, and they would do the best they could.

The Chairman: I will then put the resolution, "that this meeting hereby empowers the directors to carry on the business of the company, to oppose the winding-up petition by Mr. Whiteley, and take such steps as they deem necessary to further the interests of the company."

The resolution was then put and carried by a large majority, only five or six hands being held up in opposition.

Mr. Whiteley demanded a scrutiny.

The Chairman said that the articles stated that a poll should be demanded in writing by at least seven members, holding not less than 5,000 shares.

This condition not being complied with, the demand for a scrutiny fell to the ground. The proceedings then terminated.

THE BRUSH MIDLAND ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

On Tuesday afternoon an extraordinary general meeting of the shareholders of the above-named company was held at Cannon Street Hotel, under the presidency of Mr. Glyn, to consider the adverse proceedings taken by certain shareholders against the company, and to pass a resolution authorising the directors to continue the business of the company, notwithstanding the proceedings of the dissentient shareholders.

The notice convening the meeting having been read by Mr. H. N. Myers, secretary,

The Chairman said: Gentlemen, we have asked you to meet us to-day, and we are very pleased to be able to meet you much earlier than in the ordinary way we should have done. But our reasons for calling you together are not perhaps altogether so pleasant. Certain shareholders, and I am glad to say they are only small in number, and represent only a small amount—as a matter of fact, there are only 18 out of 800, only representing 149 shares—have, taking advantage of what they allege is a misstatement in the prospectus, thought fit to bring actions against this company for the return of their money. Well, I dare say some of you have noticed that a petition in Chancery has been filed to wind-up this company. This was done by a friendly shareholder—a large shareholder—who has no wish to wind-up the company; but he certainly does wish that these 18 shareholders should not come in and get a priority of claim over us, supposing this mistake should turn out on the decision of the court to be a material one. All this fuss and bother comes from the word "exclusive" having got into the prospectus which was issued in May. It is not denied that we have the exclusive right to the very valuable concession of the Brush dynamo machinery. But it is pretty nearly clear that we have not the exclusive right to the Lane-Fox lamp. We have had some very curious letters from shareholders in which they a little mix the dynamo and lamp together. The Brush dynamo machinery we *have* got, the Lane-Fox lamp we do not appear to have the exclusive right to. But the first question would be, "How came we to say that we have the exclusive right to a thing which we have not?" Well, gentlemen, that is a very hard question to answer. Whether the Anglo-Brush Corporation purposely suppressed the fact that Mr. Lane-Fox had given the use of the light to another company, the British Electric I think, or whether they overlooked it, I cannot say. We have only *pari passu* the liberty to use the light of the British Electric Company in our district. Now, there is another very remarkable thing about this—some of the board of more than one of these subsidiary companies are gentlemen who are also directors of the parent Brush Company. One would have supposed that these gentlemen would have known what they were talking about. There is one thing I should like to tell you. We have a clean licence from the Brush Company to use this Lane-Fox lamp. We got no notice from them in any shape or form that there was any previous licence to the British Electric Company, and I do not know, in the absence of such notice, that we should be supposed to know that any such licence existed. What legal claim there can be against the Brush Company or anybody else I can't tell you; I leave it to our solicitor. I have had so much bother and trouble over this company that if anybody can be made to suffer for this mistake in the prospectus it shall be done. There is another curious thing ,that it passed through the hands of solicitors of high standing, through those of our solicitor and those of many others. We have never paid a single farthing for Lane-Fox lamps; we paid for Brush dynamo and machinery. The real secret of the whole thing is this, the solicitors seeing that we had nothing for it, did not go so carefully into the rights as they might have done. Well, all these matters are really legal matters which we have not come here to consider, and really could not settle if we had. We want to see whether we have been injured, commercially speaking, by the loss of the exclusive right to the Lane-Fox. We have not lost, I say, one single sixpence by the loss of the exclusive use of the Lane-Fox. We have got all the lamps we required. That the British Electric Light Company can compete with us in our district is too absurd to dwell upon; and seeing that the Electric Light Bill has compelled us to supply any lamp the consumer chooses to take, I think that the Anglo-American Brush Company could not confer a greater favour upon this company than to take their Lane-Fox and just allow us to buy the best lamp in the cheapest market. There are only two courses before us in consequence of these actions; one is liquidation, and the other going on with the company. But I do not think any gentleman here can consider that the word liquidation is a pleasant one. How should we stand if you liquidated? why, you would have a certain amount of machinery—our great assets would be our concession from the Brush Company. I do not think, however, that anybody would give a large sum of money for the concession. Electric lighting is in rather low water just now, and our plant in the hands of a liquidator would not fetch much. In my opinion liquidation would be simply suicidal. Shall we go on? The answer to that gives rise

to the question what have we done up to the present time? The prospectus was issued in the middle of May; of course it took a long time to get into ship-shape—getting agents, officials—so that we have only been actually working about four months. In these four months we have actually paid our expenses, and these expenses not only included advertising and running about for orders, for we have to go after them and get permission to put our light up, but it further included expenses for installations which we have been obliged to make as advertisements at Boston, Chester, Reading, Gainsborough, and Grimsby. These are some of our places at which we have found it absolutely necessary to show that our light would burn. I do not think that a company which in the first four months could pay its expenses is so contemptible a thing as to be wound up. We have made some money out of somebody. We have lighted up the town of Cleethorpes. There we have done very successfully with arc light, and arc light is really our profitable light. Incandescent has not got to that perfection which makes it worth going out of our way to beg for incandescent lighting. Our district is mainly one of factories. We get power at the factories, and the manufacturer can thus afford to put up things so much cheaper than if he had to buy machinery, and so on; there, I think, we shall get some incandescent lighting. At Nottingham we have done very well indeed. We put up an installation there, in the factory of Messrs. Burkin Brothers, and so satisfied have they been that they actually invited their friends to see it. At another place in Nottingham we have done the same thing with another large firm, and at Lincoln we have also done some very good business. Now we have got the following contracts, which are either about to be settled, or which we shall get, and I think when you listen to me you will be much astonished that our officials have accomplished so much in so short a time. In Oxfordshire we have five contracts ready—by the way I would have you understand we do not put up any light now except it pays us. We have in Nottingham four contracts, in Leicester one (very important), which it would not be for the interest of the company for me to name. Carnarvon one, Chester one, Cleethorpes one, Stockport one, Frodingham one. You must not forget this point, that every installation which we put up not only does it pay, but it is an advertisement for us. All these contracts, I gave instructions to our manager, were to await the decision of this meeting. If you choose to liquidate all these contracts go to the wall; if you choose to go on, there is profit enough in them to pay you a very fair dividend. A good many hard things have been said and written about the subsidiary companies and their directors; but I think the best answer is to let a critic alone, and to show by actual working that you are able to prove that you can make a profit by decent legitimate commercial working. What is to be the future of electric lighting I should think nobody could say; it is very clear to me that this company, even if it goes on in the hum-drum way it is going now, will be all right. We are running no risk; we are not like a bank. If we are not able to pay any dividend next year we will not put up anything where we cannot get any profit. It seems to me that liquidation would be idiotic. The proper thing for us to do is to go on in the same quiet way as we are, endeavouring to make as large a dividend as we can. The resolution we propose to pass is, "That this meeting, having heard the statement of the chairman as to the company's position, is of opinion that the business of the company should be continued, notwithstanding the proceedings of the shareholders who have demanded the return of their money; and therefore requests the directors to arrange for the immediate withdrawal of the petition."

Mr. Bedford said that he was sure that himself and his fellow shareholders could not but be gratified at what the chairman had stated as to the progress of the company. It was time such statements were circulated, for they had heard lies and falsehoods from every quarter for the last few months told about them, and they had not said a word in reply. There should be a stand made by those interested in electric lighting. The electric light was not a mere toy, it was an established fact, an industry that was bound to be profitable. In 1881, when he was a small shareholder in the Anglo-American Brush Company, he had visited the United States, and he had become an observer of the system there, and had set himself to find how it was progressing. He found that in factories they were doing a very handsome business. It was no mere tale what was told in the public prints some months since, that the original Brush Company's shares were selling at 7,000 dollars for every 100 dollars' worth. It was really true; they were doing a business that was simply enormous. In New York, in 1881, he found a few lamps only. He found one lamp only in Boston, and that was a Brush arc light at a chemist's shop in Washington Street, of which the chemist himself knew nothing, nor where more were to be seen. He visited other places also, and came away with the thought that so far as the cities and towns of the United States were concerned, the electric light would progress very slowly. In the large towns the politicians ruled, indeed the mayors and aldermen, and the common councillors, and the street commissioners were politicians almost by trade. They were elected for a year or two, and they wanted to make the most of it. By these every effort was made to push aside a new light in the face of the great gas monopoly. On his visit to the United States last September, he was still more interested in the electric light than before, and he was again anxious to find what it was doing in its native home. He was used to the vigour and energy of Americans, but he was surprised when, in New York, he saw the progress made in a year. The Broadway and the Fifth Avenue were simply ablaze. So also was the Bowery, the democratic headquarters of New York. But of the incandescent light he saw nothing: the Brush arc light was in the ascendant all through. Large dry goods houses had it and it was all the go along the side streets. In Boston, where in 1881 he had found a single light, he 'nd the streets ablaze. In Washington Street, in all the ations, it was the only light used, and he did not think he saw one light outside of the Brush system. The question arose, was this a permanency? He could only say that these lamps appeared to have been put up in a very substantial manner, on standards 50 ft. or 60 ft. high, and the gas lamp-posts had been dismantled.

The Chairman: I may be excused for interrupting you, Mr. Bedford, but I should like to say that the gas company at Cleethorpes, which town we have lighted, in a rage took up all the gas mains (laughter).

Mr. Bedford (continuing) said that the lamp-posts in Boston were now used as sign-posts at the corners of the streets. The price of gas had been reduced to 2 dols. per 1,000 ft.

Mr. Braithwaite seconded the resolution. He was glad at the opportunity they had had of meeting the directors, and of hearing the exceedingly frank and satisfactory statement of their affairs. They had not got the sole and exclusive right to the Lane-Fox lamp, but they had of the dynamo machines, and they had that right, too, over fourteen counties of England. A dynamo, admitted to be perhaps the most efficient in the world for arc lighting, was a very valuable concession. It alone could work such a number of lights on one wire; they could have arc lights over a circuit of many miles. The wire for the little bit of Jablochkoff on the Thames Embankment had cost £3,000, whereas the cost of laying a Brush wire would be only £150, and their dynamo was the only one that could send power over a long distance. As the question of accumulators cropped up daily, it might yet be found that the Brush dynamo was the best suited for the transmission of currents of high energy. Their arc lamp was *the* lamp *par excellence*. Nine out of ten of the arc lamps used in this country were Brush arc lamps. It spoke volumes for it that it was used on the Great Eastern Railway, the Great Western, at Charing Cross, and at Waterloo, besides many other parts of the country. It spoke volumes that people would come to them and order a 10-lighter machine for a year, and after a while come back and tell them to take away their 10-lighter and put up two 40-lighters instead. That was sufficient to show that the lamp was a commercial success. With regard to the Lane-Fox lamp, it was a very good one. He had had it in his own house lately—it had lighted them for the last three months. He had also tried others. But with his present Lane-Fox he had not broken a simple lamp since be began running it. The British Electric Light Company, under their agreement with Mr. Lane-Fox, have no right to sell the lamp under the name of the Lane-Fox. They must give it another name, so that nobody would know they were selling the Lane-Fox. They had not yet sold a single lamp in the district of the Midland Company. He thought they had not energy enough. He thought, further, that a sub-company, established only so short a time as theirs, should in the first four months' work—and that in the summer months—pay its own expenses was a very satisfactory concern, and that fact alone highly commended its management. It seemed to him that they would have a dividend on their stock at no very distant date, when he believed the shareholders would think they had got hold of one of the best commercial speculations that had been offered to the public for many years. He would conclude by expressing his confidence in the company and its management—a company with only the small capital of £60,000 paid up, and yet with that sum was doing a sound, lucrative, and increasing business.

The Chairman then put the resolution amidst cries of "All all."

Mr. Stuart said, before the resolution was put, the question seemed to him rather to be how the dissentient shareholders were to be met.

The Chairman: Well, if that is the case, it is only a question of £230.

Mr. Stuart thought if it was to be paid by contesting matters it was well, perhaps, to see if it was right.

Mr. Paton said he did not see that the question of paying over entered into what they were discussing that day. Somebody was liable for that trifling mistake in the prospectus.

Mr. Braithwaite said if it came to that, that it was necessary, he for one would be happy to sign a little statement, by which the shareholders condoned the error in the prospectus.

The Chairman again put the resolution to the meeting, and it was carried with one dissentient, a Mr. Nash, a holder of 10 shares.

The Chairman said that was all the business before the meeting, and he would ask the shareholders to sign the resolution as they passed out of the room, so that the board might show they had the support of the meeting against any little minority who troubled them in that mosquito kind of business they had had lately.

Mr. Paton in moving a vote of thanks to the chairman for his "truthful, manly, and straightforward" statement of the position of the affairs of the company, said he was an original allottee, and he never meant to part with his shares. He had sufficient faith in the company not to do that.

The motion having been seconded,

The Chairman very briefly replied, and the proceedings concluded.

ORIENTAL TELEPHONE COMPANY (LIMITED).

UNDER the presidency of Mr. John Pender, M.P., an extraordinary general meeting of the members of the above-named company was held at Cannon Street Hotel, on Monday last, for the transaction of special business.

The notice convening the meeting having been read by the secretary, Mr. W. G. Hall,

The Chairman said: Gentlemen, the object [illegible] to-day is to ask you to confirm a sale of rights to a c[illegible] in Bombay; the second to take powers to make similar sal[illegible] where without the necessity of calling a special meeting. [illegible] last had the pleasure of addressing you, and referring to the [illegible] I made the following remarks: "We have not yet attempt[illegible] sales of privileges which we hold in India. I expect befor[illegible]

having now established these important exchanges in the important centres of commerce I have mentioned, and looking to the stations at which the Government wish us to offer them assistance, to adopt the principle which has been adopted in England, of forming small companies, who will pay us a certain sum for the privileges we possess, and that we shall at the same time retain a certain interest in these companies. That is the mode by which we propose to extend our system in India, keeping down our capital account and basing our extensions on the creation of companies who will find the capital to carry out these extensions." The object of the meeting to-day, then, is to ask you to confirm an agreement which we have made with the local company in Bombay for the purpose of carrying out our system in that presidency. We are to receive for our interests there, cash £30,000, less expenses, and shares—£30,000—which will continue, of course, in our possession. This gives us the advantage of local interest in carrying on the work, and it gives us a very good sum to start with, and it gives us, also, about half the working of the concern. We have thought it well to establish and prove our patents, and so we have pursued a different policy from other companies, who have generally sold their interests before they have well established them in any place. We have thought it better to prove the system, showing the people the effects that are likely to arise from the working of it, and upon that principle we have adopted that policy, and the meeting to-day is to confirm the first important sale or arrangement made in that direction. Before asking the solicitor to read the resolution, I think it is right I should give you a little history of our present position, not only in Bombay, but in other parts of the East where we have established our system. In Bombay we have something like 70 subscribers. These are handed over to the new company, and I have no doubt they will show very soon a very much larger number of subscribers. We have also secured the work for the municipality, the police and fire stations. We expect, also, to make communications for the Government, and where the Government take up a system it is generally an acknowledgment of its utility, and consequently others follow. We know the rule that wherever one merchant takes it up another merchant must follow. It is one of those systems which are more or less so concentrated that it becomes a positive necessity in a large commercial town that every commercial house should be in connection with the exchange. We therefore look forward to a very marked success in Bombay when it is under local management, in the hands of men who are deeply interested in its promotion. In Calcutta we are endeavouring to follow out the same course. Any one who knows anything of India and of the peculiar mode with which India is governed, will sympathise with us in the difficulties we have to contend with against the Indian officials. But I am happy to say that the Indian Government, not only those at the head of the Government in India, but all those at the head of Indian Government in England have lately taken a very different view, and are determined to pursue a different policy. They have given me a positive assurance that we shall have fair play. We believe eventually that the small executive will have to give way to the large executive to enable us to carry out our system in Calcutta as we have in Bombay. In Calcutta we have now something like 100 subscribers. I hope next time I meet you I shall be able to announce the formation of a private company there. In Madras we have thirty subscribers, and the Government are now having the system applied to the offices, so that we hope for some extension there. But Madras is hardly the place for going forward rapidly. In Rangoon our last advice told us we have twenty-one subscribers and twenty-four police, and part of the commissioner lines. This place also promises an increase. Kurrachee has been, so far, disappointing; still, when once introduced and in such a climate, we cannot help thinking greater things will follow. In Colombo and Ceylon thirty subscribers, and we anticipate a very considerable increase of our system there. I believe it can be carried out there to a much larger extent through connecting the different coffee estates. In China we are making some progress, but there also we have not gone quite so fast as we expected. We found some of the merchants endeavouring to work a system amongst themselves. They have now formed themselves into one body which is now controlled by us. In Shanghai we have seventy-three subscribers. At Singapore we have a very active system going on; that system was pretty well inaugurated by the Eastern Telegraph Company, which I have the honour to represent. The active manager thought that the telephone might be made a feeder of the telegraph system generally, and he established there a very successful system. We have purchased that from him at very little more than cost. He had one or two merchants associated with him, and we had to pay a small sum for what he had acquired in the way of business. For this we paid £2,990 cash, and an equal number of £1 shares of this company; at present there is a gross revenue of £1,600 obtained from that, the net income being £1,100 a year. There are seventy subscribers. One place where probably we had made greater advances than anywhere was in Egypt, when the unfortunate crisis took place there. I am glad to say we are almost again in good working order. The Government has taken up the telephone; it proved to be of very great use during the time the Admiralty had possession of Alexandria, so much so that they addressed a letter of thanks to the company for the great use the telephone proved to them during the time of the occupation. We shall also, I have no doubt, be repaid by the Egyptian Government for the injury which we sustained during the crisis, and that will amount to something like £8,000 or £9,000. We have now in Alexandria ninety-four subscribers and twenty-one connected with the Government offices—altogether, 132; at Cairo sixty subscribers. We hope in a very short period to establish an independent company there. We have a telegram to the following [illegible]: "The reinstatement of telephonic communication in Alexan[illegible] approaching completion. By next mail I hope to send you a [illegible] subscribers connected up." It is a sign of the progress of [illegible]hone to be able to state that notwithstanding the [illegible] of affairs in Egypt we have not virtually lost a [illegible] You all know of the destruction of the houses and property in Alexandria, so that I think we have a good deal before us when the city is rebuilt, and I look forward to Egypt being a very important station in the future. We have, notwithstanding all this state of things, received the first remittance of money from Egypt. It is true it is small a sum; but when once started we shall be receiving it steadily. The first system which we had opened, taken over from the vendors, was in the Hawaiian Islands. The Exchange in Honolulu has 260 subscribers, 30 of them being from the Government with an application for about 30 more, there being there a good revenue of 10,000 dollars a year, our interest in the company being one-half. Looking to the territory which we occupy, the telephone is so well suited for it, that it is merely, in my own opinion, a matter of time. In Australia—Sir Julius Vogel is there at the present time looking up that part. We have altogether about as much in hand now as our capital enables us to deal with. We have only had £60,000 cash to carry on all this work, and until we sell some of these systems, we think it is not desirable to unduly push them so as to put us under the necessity of making calls upon our shareholders. We can meet these requirements better by issuing the 20,000 shares which we got back, or rather which we kept back from the vendors in the settlement with them on account of some little irregularity. We have really 25,000 shares, 20,000 of which we propose to issue. These shares are something like 16s. in the market; we propose to issue them to the shareholders at 12s. 6d. or 2s. 6d. above par, thus giving the shareholders the opportunity of taking them *pro rata*, according to their holding. That will give us £10,000, because there is only 10s. paid up on our shares, and with the sum of money which comes from Bombay I hope we shall be able to pay our first dividend to the shareholders, and this probably before the end of the year. With these remarks I shall ask the solicitor to read the agreement with the Bombay company; I may say that we have in Alexandria 132 subscribers; in Cairo, 60; in Bombay, 81; in Calcutta, 108; Madras, 30; Rangoon, 36; Kurrachee, 15; Colombo, 30; Hong Kong, 15; Shanghai, 73; Singapore, 70; Honolulu, 289. The Chairman then proposed the following resolution: "That this company hereby approve, ratify, and confirm an agreement dated the 8th of August, 1882, and made between Clement Davidson Leggatt, as the agent of this company in India, of the one part, and John Grey Russell, as the trustee for and on behalf of a company then about to be formed and incorporated under the name of 'The Bombay Telephone Company, Limited,' of the other part, whereby it has been agreed, subject to confirmation by this company, to sell the business, goodwill, plant, and property of this company in the Bombay Presidency, Scinde, and Hyderabad, Deccan, to the said 'Bombay Telephone Company, Limited'; and do hereby authorise and require the directors of this company to carry such agreement into effect, either with or without any modification or new terms, which they may agree to on behalf of this company."

The Solicitor to the company here read the agreement, after which

Mr. Ackers inquired whether there was any real meaning in the statement in the agreement with reference to the Native States of India. There was nothing in the resolution to that effect, but the agreement states that it should be the right of the Bombay Company to sell the rights of this company in all the Native States of India.

In answer to Mr. Knight,

The Chairman said they would take in outlying places of the Native States, such as gentlemen's domains. The Bombay Company were entitled to deal with these private gentlemen, and the more they got of them the more profitable would the enterprise be to the company.

Mr. Knight said the doubt that was raised in his mind as to whether the agreement applied to the whole of the Indian Native States was raised by the fact that Hyderabad was not under the political control of the Bombay Government. Some were under the control of the Supreme Government; all the Deccan States were under the control of the Bombay Government. He thought the statement in the agreement would mean all the Native States. He thought it needed to be qualified by some statement so as to confine it to the political control of the Bombay Government, if that were so.

The Chairman remarked that those Independent States were independent only so far as their revenue was concerned, but were subject more or less to the supervision of the English Government. The outlying places would afford them capital material for work. It would be a great thing to get these Independent Native States worked. The board thought it was better that these should be worked by the Bombay organisation, because they believe there was more enterprise there than in any other centre in India.

Colonel Gouraud, one of the directors, said that the significance of the important questions which had been asked was covered by the fact of the questioners retaining such a large interest in the shares of the company. Still, they could hardly over-estimate the importance of the questions asked. He wished to speak first as a shareholder, his excuse being that he had a very large interest in the company. He had taken but an insignificant part in the negotiations with regard to the Bombay Company—in fact he was not in the country when these negotiations were carried on. On his return, this being the first sale, and carrying out that line of policy which the chairman had indicated at the last meeting, he had made an exceptional investigation into the terms of the contract, for which perhaps he had had an opportunity exceeding that of any other shareholder. He had made this investigation very thoroughly. He was happy to say that he had found that it was an exceptionally favourable contract for this company. He had had something to do with nearly all the contracts which had been made for the sale of concessions since the birth of the telephone. He looked upon it as a good augury that the Bombay merchants had joined the board and would be responsible for the management of the company in Bombay. They must not think that the good bargain on their side was a hard bargain for the other side. It had been a case of give and take. They had something which was wanted in Bombay, and which they could not get on without. There was no civilised community who could get on

to agree to all intents with that obtained from the ratio of the speeds. M. Deprez, therefore, ignores the loss along the line.

Whatever may be thought of M. Deprez's experiments and the critical remarks to which they have been subjected, he has decidedly taken the lead in concentrating public attention on the subject of transmitting power to long distances. Although the subject has recently been brought forward in such a way as to lead many to believe that this able French engineer was the originator of transmitting motive-power by electricity, the experiments of Siemens, Werdermann, Fontaine, and others in past years should not be overlooked. We ourselves remember, shortly after the first Gramme machines were constructed in England, a long series of experiments made by Mr. Werdermann on this very subject. He may probably still have the data of the results obtained, but the tests were made over very short distances. But to M. Marcel Deprez belongs the honour, not of being the original instigator of these important researches, but of having carried out the ideas of others on a large enough scale on which to form a commercial basis.

We heartily wish that exhaustive trials on the electrical transmission of power may shortly be made in England, and that the electrical result, and the result in actual work produced, may not be so intimately mixed up as to create such a misunderstanding as has apparently been the case over the Miesbach-Munich experiments.

Since writing these lines we have received a communication from M. Hospitalier on the same subject, which will be found in our other columns.

BROCKIE'S ELECTRIC ARC LAMP.

AMONGST the many successful inventors of electric arc lamps Mr. Brockie has gained a high position. He struck out a new path for himself in his first lamp, which our readers well know is regulated by periodical commutation by means of a circuit separate and independent of that used for the main current. Therefore we may assume that any further outcome of Mr. Brockie's inventive powers will interest electrical engineers to a more than ordinary degree.

The subject of this article appears likely to prove as great a success in its action as did the inventor's original lamp, for although since that time arc lamps have been brought forward in such numbers, and in some instances possessed of such simplicity that it seems doubtful whether any better devices could be imagined, yet Mr. Brockie's present invention is apparently possessed of such good qualities that we should not be surprised to find it take as favourable a place in public estimation as any now in use.

The description of this simple and ingenious lamp may best be put forward in the words of the inventor's specification :—

"Fig. 1 is a view of the regulating escapement of an electric arc lamp constructed according to my invention; fig. 2 shows a complete lamp with my improvements applied, and fig. 3 shows a regulating motor for electric lamps constructed according to my invention. Similar letters of reference refer to like parts in all the figures.

"In all electric arc lamps hitherto constructed which regulate by the action of a magnet or solenoid either in the main circuit or in a shunt across the arc, or by a combination of both, the regulating armature, or core, bears a certain and definite mechanical relation to the releasing or feeding mechanism (usually a brake or clutching device) the armature being jointed directly or by levers to the disengaging brake or clutch. Now, I propose to do away with the [illegible] or direct connection, and to gear the regulating armature to the brake or other device by simple friction, or the friction of magnetism, as in fig. 1, so that the armature, B, is free to take up various positions in relation to the brake-lever, C, and yet control it. I limit the play of the brake or its lever between two stops, D D, this play being preferably very small, but the regulating armature or core, B, may have a much longer travel, or play; thus it will be seen, as above stated, that the armature may take up various positions in relation to the brake-lever, the particular position, however, being determined by the strength of the current, thus no alteration in the tension-spring or balance-weight acting against the armature is necessary even for much variation in the current, as the armature will accommodate its position automatically to the current employed.

"I have found by observation that the resistance of an arc is very constant when it is of a suitable length for the size or quality of the carbons and the strength of the current, but immediately this length is exceeded in the slightest degree the resistance becomes fitful and difficult to measure.

FIG. 1.

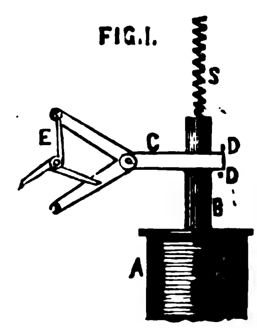


FIG. 2.

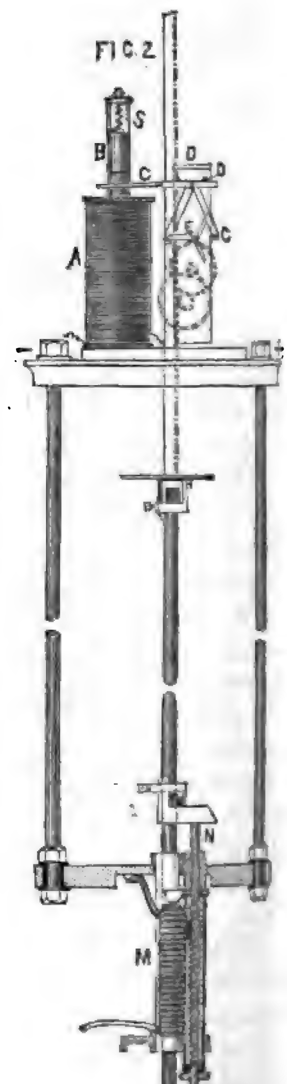
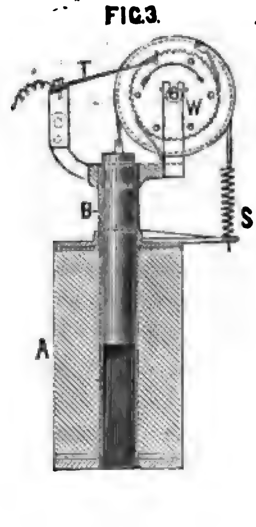


FIG. 3.



"Now I take advantage of this fitful resistance of the arc to secure the readjustment of the carbons—that is to say, when the resistance of the arc becomes irregular I cause this very irregularity to produce a mechanical regulating movement, and so long as the resistance remains steady or constant no movement takes place. In order to take advantage of this irregularity in the resistance of the arc and cause it to produce mechanical action and thereby regulate an electric arc lamp, I place a solenoid or magnet, A, in a shunt across the arc, as in fig. 2, the core or armature, B, of which will vibrate when the resistance of the arc is variable and remain still when constant. I cause this core, B, to work an anchor or escapement device, C, by the friction attachment before described, which allows the carbons to approach each other a definite distance at each vibration by permi[illegible] the escape-wheel, E, to pass, and as long as this vi[illegible] movement continues the carbons will be gradually app[illegible] ing each other or the distance between them be l[illegible]

until the arc regains its stability, when, of course, the vibratory movement will cease and the feed be arrested. The arc in such a lamp is first obtained by means of the magnet, M, drawing down the lower carbon-holder, N.

"It will be seen that by gearing or connecting the solenoid core or magnet armature, B, to the escapement device abovementioned by means of the frictional method above explained, no alteration in the tension-spring, S, is necessary in such a lamp to suit variations in current unless those variations are very great.

"Another mode of utilising this unstability of the arc for the purposes of adjusting the carbons is to cause the oscillations of the armature or core of the shunt coil, A, fig. 3, to rotate a wheel, W, by means of a pawl and ratchet, or equivalent means, this said wheel at each revolution or part of a revolution to make a contact, T, which contact might be made to complete a branch circuit and this latter to reverse the polarity of the arc-striking or adjusting magnet in an electric lamp; indeed, I propose to use a motor which would be revolved by the oscillations of an armature due to irregularities in the resistance of an arc or current. In order to effect the re-adjustment of the arcs in electric lamps the particular construction of which lamps may be various without affecting the principle of this part of my invention."

THE ELECTRIC LIGHTING CONFERENCE IN SOUTH LONDON.

On Tuesday, the 14th inst., the adjourned conference of delegates from the various vestries and district boards of South London to consider the provisions of the Electric Lighting Act, took place in the Camberwell Vestry Hall, under the presidency of Mr. E. Dresser Rogers. We alluded to the preliminary meeting in our issue of the 4th inst.

Mr. Winnett (clerk to the Lewisham Board of Works) thought the first question to decide at this conference would be as to the action to be taken by those parishes that had not considered the question of electric lighting. In his opinion it would be advisable that the vestries should take out a licence, which, at the end of seven years, came to an end without any conditions whatever. He threw it out as a suggestion that certain definite rules should be drawn up by the united vestries and district boards to be inserted either in a licence or provisional order.

Mr. Morton (Wandsworth Board of Works) was of opinion that the district boards should not play into the hands of the companies before more was known than at present concerning electricity and what could be done by the companies. He moved the following motion: "That in the opinion of this conference it is desirable that the supply of the electric light, both for public and private purposes, should be in the hands of the local authorities. That, considering the present uncertainty as to the cost of applying the electric light over large areas, and bearing in mind that the City Corporation are about to at once try the experiment of supplying the light to all persons in the City, it would be, in the opinion of this conference, wise and to the interest of the ratepayers that the local authorities should take no further steps in the matter for a time, except to prevent companies from creating monopolies in the various districts, and to be prepared as soon as fuller information could be had as to the cost, &c., of supplying the light, to give the public the advantage of so excellent a means of lighting."

This having been seconded, the Chairman, in reply to a questioner, stated that the Board of Works, with the intention of encouraging electric lighting, were induced to accept a contract with the Jablochkoff Company to light the Thames Embankment. Since then they had gradually increased the number of lights, and they had never for a single night ceased to have the electric light under their control. All he could say was that the cost of electric lighting was found by the board to be very much less than it was at first. The progress made had been so far satisfactory that the Embankment had been lighted at a difference of cost of something like three-halfpence per candle per [illegible] as compared with sixpence. He would say nothing [illegible] the difference between the cost of electricity and

Mr. Fowler (Lambeth) could not support the motion of Mr. Morton. In the first place the Act of Parliament could not be over-ridden by anything or anybody. The vestries and district boards were at the mercy of the Act, and it came to this—that the vestries would be compelled to do something themselves, or oppose the companies with the object of obtaining the best terms possible in the interests of the ratepayers. The chief difficulty he saw in adopting the electric light was the enormous cost of undertaking it. The money must come from some quarter, and it was questionable whether the Metropolitan Board would be disposed to lend it on such a security. This conference should hesitate before doing anything in the dark. There were several features in the Act which might have been objected to had it secured adequate attention at the hands of those interested in it before it was passed.

Mr. Dunham (clerk to the Newington Vestry) pointed out that although Newington would apply for a licence for the whole area of the parish, the compulsory clauses would only refer to the main roads. It would be permissive on the part of the Vestry to light the bye-streets with electricity. Referring to Mr. Chandler's figures given at the last conference, Mr. Dunham remarked that it did not follow that because the first four miles of streets would cost an initial £8,000, the other thoroughfares would cost the same in proportion. As a matter of fact, he did not think it would cost Newington more than £15,000 to start with. Supposing that the rates were increased twopence or threepence in the pound, would it not be a good investment if they succeeded in bringing down the price of gas? His (Mr. Dunham's) opinion was that the vestries ought certainly to take advantage of the Act at the present time.

Mr. Middlemass (Camberwell) said it was important to bear in mind that the cost of electricity would be less and less every year. The cost of electricity in the past had included the cost of experiments, but in the future it would simply be the commercial cost of the article in proportion to the number of persons to be supplied. He commended the action of Newington in this matter. The vestries would be neglecting their duty to their constituents if they failed to take steps to possess the option of supplying the electric light, and of preventing anybody obtaining a monopoly.

The resolution was put and negatived, only two voting in its favour.

Mr. Winnett then moved—"That this conference recommends such vestries and district boards as do not intend to become undertakers themselves, to grant consent to licence to such companies as they may select, and upon such conditions as may be determined, thus preventing the provisional orders being obtained."

Lieutenant-General Mould seconded.

Mr. Fowler deprecated the consideration of such matters as those contained in the resolution, and reminded the conference that the broad issue was whether the vestries should be recommended to take out a licence. It did not follow, even supposing the licence was taken out by the parish, that the vestries should themselves undertake the actual lighting.

Mr. Yates remarked that even if they did not undertake the actual licence, they would be responsible for it at the cost of the ratepayers.

Mr. Middlemass opposed the resolution, and remarked that the vestries would be guilty of cowardice if they failed to accept the responsibilities laid upon them by the Electric Lighting Act.

The resolution, which was only supported by three gentlemen, was negatived.

Mr. Fowler moved—"That it be reported to the various vestries and district boards, that inasmuch as the provisions of the Electric Lighting Act require local authorities to elect, before the 25th of January next, either to apply for licences themselves, or permit the undertakers to apply for provisional orders; and inasmuch as the President of the Board of Trade has declared that the Act of Parliament must be carried out, in the opinion of this conference the local authorities should be advised to apply for licences so as to keep the power in their own hands."

Mr. Middlemass seconded, and the resolution was carried with only one dissentient, and the proceedings closed with a vote of thanks to the chairman and to the vestry of Camberwell for having called the conference together.

The Chairman, in reply to the vote of thanks, reminded

the delegates that he took great interest in the gas question twenty-five years ago. He hoped and trusted that the work of the delegates would result in an improvement in the lighting of our streets in the future by the electric light.

The proceedings then terminated.

At a meeting of the Camberwell Vestry on the following evening the advisability of holding a special meeting to consider the best means of adopting the Electric Lighting Act was discussed. Mr. E. Dresser Rogers again presided and there were about fifty gentlemen present.

Mr. Middlemass, in a speech dealing exhaustively with the subject of improved lighting, moved—"That the vestry clerk be directed to convene a special meeting of the vestry, with one month's notice pursuant to the statute, in order to enable the vestry to decide whether a licence shall be applied for by the vestry, or consent given to a licence or provisional order to one or some of the electric light companies."

The motion was seconded, when

Mr. Preston moved, as an amendment, to add to the above motion the words—"or what steps, if any, the vestry will take in the matter."

The motion as amended was agreed to, after a somewhat lengthy discussion.

Mr. Middlemass then moved, pursuant to notice—"That the vestry clerk and the surveyor be directed to obtain information as to the views and terms of the electric lighting companies for the supply of the public and private lighting of the parish."

Mr. Duckett seconded the motion.

Mr. Simmons moved, and Mr. Duckett seconded, to add to the motion the words—"And that the same be summarised, printed, and sent to the members one week before the meeting is called."

This amendment was carried as part of the original resolution, which was also adopted.

This terminated the proceedings.

DR. SIEMENS' ADDRESS TO THE SOCIETY OF ARTS.

After some preliminary remarks on the history and formation of the above Society, Dr. Siemens said:—

Amongst the practical questions that now chiefly occupy public attention are those of electric lighting, and of the transmission of force by electricity.

The dynamo machine, which enables us to convert mechanical into electrical force, purely and simply, properly conceived and well constructed, converts more than ninety per cent. of the mechanical force imparted to it into electricity, ninety per cent. again of which may be re-converted into mechanical force at a moderate distance. The margin of loss, therefore, does not exceed twenty per cent., excluding purely mechanical losses, and this is quite capable of being further reduced to some extent by improved modes of construction; but it results from these figures that no great step in advance can be looked for in this direction. The dynamo machine presents the great advantage of simplicity over steam or other power-transmitting engines; it has but one working part, namely, a shaft which, revolving in a pair of bearings, carries a coil or coils of wire admitting of perfect balancing. Frictional resistance is thus reduced to an absolute minimum, and no allowance has to be made for loss by condensation, or badly fitting pistons, stuffing boxes, or valves, or for the jerking action due to oscillating weights. The materials composing the machine, namely, soft iron and copper wire, undergo no deterioration or change by continuous working, and the depreciation of value is, therefore, a minimum, except where currents of exceptionally high potential are used, which appear to render the copper wire brittle.

The essential points to be attended to in the conception of the dynamo machine are the prevention of induced currents in the iron, and the placing of the wire in such position as to make the whole of it effective for the production of outward current. These principles, which have been clearly established by the labours of comparatively few workers in applied science, admit of being carried out in an almost infinite variety of constructive forms, for each of which may be claimed some real or imaginary merits regarding questions of convenience or cost of production.

The essential features involved in the dynamo machine, the Siemens armature (1856), the Pacinotti ring (1861), and the self-exciting principle (1867), were published by their authors for the pure scientific interest attached to them, without being made subject matter of letters patent, which circumstance appears to have had the contrary effect of what might have been expected, in that it has retarded the introduction of this class of electrical machine, because no person or firm, had a sufficient commercial interest to undertake the large expendi[illegible] which must necessarily be incurred in reducing a first conc[illegible] practical shape. Great credit is due to Monsieur C[illegible] ing the initiative in the practical introduction of dynamo machines embodying those principles, but when five years ago I ventured to predict for the dynamo-electric current a great practical future, as a means of transmitting power to a distance, those views were still looked upon as more or less chimerical. A few striking examples of what could be practically effected by the dynamo-electric current, such as the illumination of the Place de l'Opéra, Paris, the occasional exhibition of powerful arc lights, and their adoption for military and lighthouse purposes, but especially the gradual accomplishment of the much-desired lamp by incandescence in vacuum, gave rise to a somewhat sudden reversion of public feeling; and you may remember the scare at the Stock Exchange, affecting the value of gas shares, which ensued in 1878, when the accomplishment of the subdivision of the electric light by incandescent wire was first announced, somewhat prematurely, through the Atlantic cable.

From this time forward electric lighting has been attracting more and more public attention, until the brilliant displays at the Exhibition of Paris, and at the Crystal Palace last year, served to excite public interest to an extraordinary degree. New companies for the purpose of introducing electric light and power have been announced almost daily, whose claims to public attention as investments were based in some cases upon only very slight modifications of well-known forms of dynamo machines, of arc regulators, or of incandescent carbon lights, the merits of which rested rather upon anticipations than upon any scientific or practical proof. These arrangements were supposed to be of such superlative merit that gas and other illuminants must soon be matters simply of history, and hence arose great speculative excitement. It should be borne in mind, however, that any great technical advance is necessarily the work of time and serious labour, and that when accomplished, it is generally found that so far from injuring existing industries, it calls additional ones into existence, to supply new demands, and thus gives rise to an increase in the sum total of our resources. It is, therefore, reasonable to expect that side by side with the introduction of the new illuminant, gas lighting will go on improving and extending, although the advantage of electric light for many applications, such as the lighting of public halls and warehouses, of our drawing-rooms and dining-rooms, our passenger steamers, our docks and harbours, are so evident, that its advent may be looked upon as a matter of certainty.

Our Legislature has not been slow in recognising the importance of the new illuminant. In 1879 a Select Committee of the House of Commons instituted a careful inquiry into its nature and probable cost, with a view to legislation, and the conclusions at which they arrived were, I consider, the best that could have been laid down. They advised that applications should be encouraged tentatively by the granting of Permissive Bills, and this policy has given rise to the Electric Lighting Bill, 1882, promoted by Mr. Chamberlain, the President of the Board of Trade, regarding which much controversy has arisen. It could, indeed, hardly be expected that any act of legislation upon this subject could give universal satisfaction, because while there are many believers in gas who would gladly oppose any measure likely to favour the progress of the rival illuminant, and others who wish to see it monopolised, either by local authorities, or by large financial corporations, there are others again who would throw the doors open so wide as to enable almost all comers to interfere with the public thoroughfares, for the establishment of conducting wires, without let or public hindrance.

The law as now established takes, I consider, a medium course between these diverging opinions, and, if properly interpreted, will protect, I believe, all legitimate interests, without impeding the healthy growth of establishments for the distribution of electric energy for lighting and for the transmission of power. Any firm or lighting company may, by application to the local authorities, obtain leave to place electric conductors below public thoroughfares, subject to such conditions as may be mutually agreed upon, the term of such licence being limited to seven years; or an application may be made to the Board of Trade for a Provisional Order to the same effect which, when sanctioned by Parliament, secures a right of occupation for twenty-one years. The licence offers the advantage of cheapness, and may be regarded as a purely tentative measure, to enable the firm or company to prove the value of their plant. If this is fairly established, the licence would in all probability be affirmed, either by an engagement for its prolongation from time to time, or by a Provisional Order which would, in that case, be obtained by joint application of the contractor and the local authority. At the time of expiration of the Provisional Order, pre-emption of purchase is accorded to the local authority, against which it has been objected with much force by so competent an authority as Sir Frederick Bramwell, that the conditions of purchase laid down are not such as fairly to remunerate the contracting companies for their expenditure and risk, and that the power of purchase would inevitably induce the parochial bodies to become mere trading associations. But while admitting the undesirability of such a consummation, I cannot help thinking that it was necessary to put some term to contracts entered into with speculative bodies at a time when the true value of electric energy, and the best conditions under which it should be applied, are still very imperfectly understood. The supply of electric energy, particularly in its application to transmission of power, is a matter simply of commercial demand and supply, which need not partake of the character of a large monopoly similar to gas and water supply, and wh[illegible] therefore, be safely left in the hands of individuals, or of lo[illegible] tions, subject to a certain control for the protectio[illegible] interests. At the termination of the period of the Pro[illegible] the contract may be renewed upon such terms and [illegible] at that time appear just and reasonable to [illegible] authority the Board of Trade will be empo[illegible] renewal.

Complaints appear almost daily in the pub[illegible] that townships refuse their assent to appli[illegible] companies for Provisional Orders; but it ma[illegible] of these applications are of a more or less [illegible]

object being to secure monopolies for eventual use or sale, under which circumstances the authorities are clearly justified in withholding their assent; and no licences or Provisional Orders should indeed be granted, I consider, unless the applicants can give assurance of being able and willing to carry out the work within a reasonable time. But there are technical questions involved which are not yet sufficiently well understood to admit of immediate operations upon a large scale.

Attention has been very properly called to the great divergence in the opinions expressed by scientific men regarding the area that each lighting district should comprise, the capital required to light such an area, and the amount of electric tension that should be allowed in the conductors. In the case of gas supply, the works are necessarily situated in the outskirts of the town, on account of the nuisance this manufacture occasions to the immediate neighbourhood; and, therefore, gas supply must range over a large area. It would be possible, no doubt, to deal with electricity on a similar basis, to establish electrical mains in the shape of copper rods of great thickness, with branches diverging from them in all directions; but the question to be considered is, whether such an initiative course is desirable on account either of relative expense or of facility of working. My own opinion, based upon considerable practical experience and thought devoted to the subject, is decidedly adverse to such a plan. In my evidence before the Parliamentary Committee, I limited the desirable area of an electric district in densely populated towns to a quarter of a square mile, and estimated the cost of the necessary establishment of engines, dynamo machines, and conductors, at £100,000, while other witnesses held that areas from one to four square miles could be worked advantageously from one centre, and at a cost not exceeding materially the figure I had given. These discrepancies do not necessarily imply wide differences in the estimated cost of each machine or electric light, inasmuch as such estimates are necessarily based upon various assumptions regarding the number of houses and of public buildings comprised in such a district, and the amount of light to be apportioned to each, but I still maintain my preference for small districts.

By way of illustration, let us take the parish of St. James's, near at hand, a district not more densely populated than other equal areas within the metropolis, although comprising, perhaps, a greater number of public buildings. Its population, according to the preliminary report of the census taken on the 4th April, 1881, was 29,865, it contains 3,018 inhabited houses, and its area is 784,000 square yards, or slightly above a quarter of a square mile.

To light a comfortable house of moderate dimensions in all its parts, to the exclusion of gas, oil, or candles, would require about 100 incandescence lights of from 15 to 18 candle-power each, that being, for instance, the number of Swan lights employed by Sir William Thomson in lighting his house at Glasgow University. Eleven horse-power would be required to excite this number of incandescence lights, and at this rate the parish of St. James's would require 3,018 × 11 = 33,200 horse-power to work it. It may be fairly objected, however, that there are many houses in the parish much below the standard here referred to, but on the other hand, there are 600 of them with shops on the ground-floor, involving larger requirements. Nor does this estimate provide for the large consumption of electric energy that would take place in lighting the eleven churches, eighteen club-houses, nine concert halls, three theatres, besides numerous hotels, restaurants, and lecture halls. A theatre of moderate dimensions, such as the Savoy Theatre, has been proved by experience to require 1,200 incandescence lights, representing an expenditure of 133 horse-power; and about one half that power would have to be set aside for each of the other public buildings here mentioned, constituting an aggregate of 2,926 horse-power; nor does this general estimate comprise street lighting, and to light the six and a half miles of principal streets of the parish with electric light, would require, per mile, thirty-five arc lights of 350 candle-power each, or a total of 227 lights. This, taken at the rate of 0·8 horse-power per light, represents a further requirement of 182 horse-power, making a total of 3,108 horse-power, for purposes independent of house lighting, being equivalent to one horse-power per inhabited house, and bringing the total requirements up to 109 lights = 12 horse-power per house.

I do not, however, agree with those who expect that gas lighting will be entirely superseded, but have, on the contrary, always maintained that the electric light, while possessing great and peculiar advantages for lighting our principal rooms, halls, warehouses, &c., owing to its brilliancy, and more particularly to its non-interference with the healthful condition of the atmosphere, will leave ample room for the development of the former, which is susceptible of great improvement, and is likely to hold its own for the ordinary lighting up of our streets and dwellings.

Assuming, therefore, that the bulk of domestic lighting remains to the gas companies, and that the electric light is introduced into private houses, only, at the rate of, say, twelve incandescence lights per house, the parish of St. James's would have to be provided with electric energy sufficient to work (9 + 12) 3·018 = 63,378 lights = 7,042 horse-power effective; this is equal to about one-fourth the total lighting power required, taking into account that the total [illegible]umber of lights that have to be provided for a house are not all used [illegible] and the same time. No allowance is made in this estimate for [illegible]ansmission of power, which, in course of time, will form a very [illegible]pplication of electric energy; but considering that power will [illegible] mostly in the day time, when light is not needed, a material [illegible] plant will not be necessary for that purpose.

[illegible] to minimise the length and thickness of the electric con[illegible] [illegible]uld be important to establish the source of power, as [illegible] be, in the centre of the parish, and the position that to my mind is that of Golden Square. If the unoccupied [illegible]uare, representing 2,500 square yards, was excavated [illegible]wenty-five feet, and then arched over so as to re[illegible] sent ground level, a suitable covered space would be provided for the boilers, engines, and dynamo machines, without causing obstruction or public annoyance; the only erection above the surface would be the chimney, which, if made monumental in form, might be placed in the centre of the square, and be combined with shafts for ventilating the subterranean chamber, care being taken of course to avoid smoke by insuring perfect combustion of the fuel used. The cost of such a chamber, of engine-power, and of dynamo machines capable of converting that power into electric energy, I estimate at £140,000. To this expense would have to be added that of providing and laying the conductors, together with the switches, current-regulators, and arrangements for testing the insulation of the wire.

The cost and dimensions of the conductors would depend upon their length and the electromotive force to be allowed. The latter would no doubt be limited, by the authorities, to the point at which contact of the two conductors with the human frame would not produce injurious effects, or say, to 200 volts, except for street lighting, for which purpose a higher tension is admissible. In considering the proper size of conductor to be used in any given installation two principal factors have to be taken into account; first, the charge for interest and depreciation on the original cost of a unit length of the conductor; and, secondly, the cost of the electrical energy lost through the resistance of a unit of length. The sum of these two, which may be regarded as the cost of conveyance of electricity, is clearly least, as Sir William Thomson pointed out some time ago, when the two components are equal. This, then, is the principle on which the size of a conductor should be determined.

From the experience of large installations I consider that electricity can, roughly speaking, be produced in London at a cost of about one shilling per 10,000 Ampère-Volts or Watts (746 Watts being equal to one horse-power) for an hour. Hence, assuming that each set of four incandescence lamps in series (such as Swan's, but for which may be substituted a smaller number of higher resistance and higher luminosity) requires 200 volts electromotive force and 60 Watts* for their efficient working, the total current required for 64,000 such lights is 19,200 ampères, and the cost of the electric energy lost by this current in passing through 1-100th of an ohm resistance is £16 per hour.

The resistance of a copper bar one quarter of a mile in length and one square inch in section is very nearly 1-100th of an ohm, and the weight is about 2¼ tons. Assuming, then, the price of insulated copper conductor at £90 per ton, and the rate of interest and depreciation at 7½ per cent., the charge per hour of the above conductor, when used eight hours per day, is 1¼d. Hence, following the principle I have stated above, the proper size of conductor to use for an installation of the magnitude I have supposed would be one of 48·29 in. section, or a round rod 8 in. diameter.

If the mean distance of the lamps from the station be assumed as 350 yards the weight of copper used in the complete system of conductors would be nearly 168 tons, and its cost £15,120. To this must be added the cost of iron pipes for carrying the conductors underground, and of testing-boxes and labour in placing them. Four pipes of 10 in. diameter each would have to proceed in different directions from the central station, each containing sixteen separate conductors of 1 in. diameter and separately insulated, each of them supplying a sub-district of 1,000 lights. The total cost of establishing these conductors may be taken at £37,000, which brings up the total expenditure for central station and leads to £177,000. I assume the conductors to be placed underground, as I consider it quite inadmissible, both as regards permanency and public safety and convenience, to place them above ground within the precincts of towns. With this expenditure the parish of St. James's could be supplied with the electric light to the extent of about 25 per cent. of the total illuminating power required. To provide a larger percentage of electric energy would increase the cost of establishment proportionately, and that of conductors nearly in the square ratio of the increase of the district, unless the loss of energy by resistance is allowed to augment instead.

It may surprise uninitiated persons to be told that to supply a single parish with electric energy necessitates copper conductors of a collective area equal to a rod of eight inches in diameter; and how, it may be asked, will it be possible under such conditions to transmit the energy of waterfalls to distances of twenty or thirty miles, as has been suggested. It must indeed be admitted that the transmission of electric energy of such potential (200 volts) as is admissible in private dwellings would involve conductors of impracticable dimensions, and in order to transmit electrical energy to such distances it is necessary to resort in the first place to an electric current of high tension. By increasing the tension from 200 to 1,200 volts the conductors may be reduced to one-sixth their area, and if we are content to lose a larger proportion of the energy obtained cheaply from a waterfall, we may effect a still greater reduction. A current of such high potential could not be introduced into houses for lighting purposes, but it could be passed through the coils of a secondary dynamo machine, to give motion to another primary machine, producing currents of low potential to be distributed for general consumption. Or secondary batteries may be used to effect the conversion of currents of high into those of low potential, whichever means may be found the cheaper in first cost, in maintenance, and most economical of energy. It may be advisable to have several such relays of energy for great distances, the result of which would be a reduction of the size and cost of conductor at the expense of final effect, and the policy of the electrical engineer will, in such cases, have to be governed by the relative cost of the conductor, and of the power at its original source. If secondary batteries should become more permanent in their action than they are at the present time, they may be largely resorted to by consumers, to receive a charge of electrical energy during the day time, or the small hours of the night, when the central engine would otherwise be unemployed, and the advantage of resorting to these means will depend upon the relative first cost, and cost of working the secondary battery and the

* We presume Dr. Siemens means 60 Watts per lamp.—Eds. Elec. Rev

the delegates that he took great interest in the gas question twenty-five years ago. He hoped and trusted that the work of the delegates would result in an improvement in the lighting of our streets in the future by the electric light.

The proceedings then terminated.

At a meeting of the Camberwell Vestry on the following evening the advisability of holding a special meeting to consider the best means of adopting the Electric Lighting Act was discussed. Mr. E. Dresser Rogers again presided and there were about fifty gentlemen present.

Mr. Middlemass, in a speech dealing exhaustively with the subject of improved lighting, moved—"That the vestry clerk be directed to convene a special meeting of the vestry, with one month's notice pursuant to the statute, in order to enable the vestry to decide whether a licence shall be applied for by the vestry, or consent given to a licence or provisional order to one or some of the electric light companies."

The motion was seconded, when

Mr. Preston moved, as an amendment, to add to the above motion the words—"or what steps, if any, the vestry will take in the matter."

The motion as amended was agreed to, after a somewhat lengthy discussion.

Mr. Middlemass then moved, pursuant to notice—"That the vestry clerk and the surveyor be directed to obtain information as to the views and terms of the electric lighting companies for the supply of the public and private lighting of the parish."

Mr. Duckett seconded the motion.

Mr. Simmons moved, and Mr. Duckett seconded, to add to the motion the words—"And that the same be summarised, printed, and sent to the members one week before the meeting is called."

This amendment was carried as part of the original resolution, which was also adopted.

This terminated the proceedings.

DR. SIEMENS' ADDRESS TO THE SOCIETY OF ARTS.

After some preliminary remarks on the history and formation of the above Society, Dr. Siemens said:—

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The dynamo machine, which enables us to convert mechanical into electrical force, purely and simply, properly conceived and well constructed, converts more than ninety per cent. of the mechanical force imparted to it into electricity, ninety per cent. again of which may be re-converted into mechanical force at a moderate distance. The margin of loss, therefore, does not exceed twenty per cent., excluding purely mechanical losses, and this is quite capable of being further reduced to some extent by improved modes of construction; but it results from these figures that no great step in advance can be looked for in this direction. The dynamo machine presents the great advantage of simplicity over steam or other power-transmitting engines; it has but one working part, namely, a shaft which, revolving in a pair of bearings, carries a coil or coils of wire admitting of perfect balancing. Frictional resistance is thus reduced to an absolute minimum, and no allowance has to be made for loss by condensation, or badly fitting pistons, stuffing boxes, or valves, or for the jerking action due to oscillating weights. The materials composing the machine, namely, soft iron and copper wire, undergo no deterioration or change by continuous working, and the depreciation of value is, therefore, a minimum, except where currents of exceptionally high potential are used, which appear to render the copper wire brittle.

The essential points to be attended to in the conception of the dynamo machine are the prevention of induced currents in the iron, and the placing of the wire in such position as to make the whole of it effective for the production of outward current. These principles, which have been clearly established by the labours of comparatively few workers in applied science, admit of being carried out in an almost infinite variety of constructive forms, for each of which may be claimed some real or imaginary merits regarding questions of convenience or cost of production.

The essential features involved in the dynamo machine, the Siemens armature (1856), the Pacinotti ring (1861), and the self-exciting principle (1867), were published by their authors for the pure scientific interest attached to them, without being made subject matter of letters patent, which circumstance appears to have had the contrary effect of what might have been expected, in that it has retarded the introduction of this class of electrical machine, because no person or firm, had a sufficient commercial interest to undertake the large expenditure which must necessarily be incurred in reducing a first conception into a practical shape. Great credit is due to [illegible]ur Gramme for taking the initiative in the practical introduction of dynamo machines embodying those principles, but when five years ago I ventured to predict for the dynamo-electric current a great practical future, as a means of transmitting power to a distance, those views were still looked upon as more or less chimerical. A few striking examples of what could be practically effected by the dynamo-electric current, such as the illumination of the Place de l'Opéra, Paris, the occasional exhibition of powerful arc lights, and their adoption for military and lighthouse purposes, but especially the gradual accomplishment of the much-desired lamp by incandescence in vacuum, gave rise to a somewhat sudden reversion of public feeling; and you may remember the scare at the Stock Exchange, affecting the value of gas shares, which ensued in 1878, when the accomplishment of the subdivision of the electric light by incandescent wire was first announced, somewhat prematurely, through the Atlantic cable.

From this time forward electric lighting has been attracting more and more public attention, until the brilliant displays at the Exhibition of Paris, and at the Crystal Palace last year, served to excite public interest to an extraordinary degree. New companies for the purpose of introducing electric light and power have been announced almost daily, whose claims to public attention as investments were based in some cases upon only very slight modifications of well-known forms of dynamo machines, of arc regulators, or of incandescent carbon lights, the merits of which rested rather upon anticipations than upon any scientific or practical proof. These arrangements were supposed to be of such superlative merit that gas and other illuminants must soon be matters simply of history, and hence arose great speculative excitement. It should be borne in mind, however, that any great technical advance is necessarily the work of time and serious labour, and that when accomplished, it is generally found that so far from injuring existing industries, it calls additional ones into existence, to supply new demands, and thus gives rise to an increase in the sum total of our resources. It is, therefore, reasonable to expect that side by side with the introduction of the new illuminant, gas lighting will go on improving and extending, although the advantage of electric light for many applications, such as the lighting of public halls and warehouses, of our drawing-rooms and dining-rooms, our passenger steamers, our docks and harbours, are so evident, that its advent may be looked upon as a matter of certainty.

Our Legislature has not been slow in recognising the importance of the new illuminant. In 1879 a Select Committee of the House of Commons instituted a careful inquiry into its nature and probable cost, with a view to legislation, and the conclusions at which they arrived were, I consider, the best that could have been laid down. They advised that applications should be encouraged tentatively by the granting of Permissive Bills, and this policy has given rise to the Electric Lighting Bill, 1882, promoted by Mr. Chamberlain, the President of the Board of Trade, regarding which much controversy has arisen. It could, indeed, hardly be expected that any act of legislation upon this subject could give universal satisfaction, because while there are many believers in gas who would gladly oppose any measure likely to favour the progress of the rival illuminant, and others who wish to see it monopolised, either by local authorities, or by large financial corporations, there are others again who would throw the doors open so wide as to enable almost all comers to interfere with the public thoroughfares, for the establishment of conducting wires, without let or public hindrance.

The law as now established takes, I consider, a medium course between these diverging opinions, and, if properly interpreted, will protect, I believe, all legitimate interests, without impeding the healthy growth of establishments for the distribution of electric energy for lighting and for the transmission of power. Any firm or lighting company may, by application to the local authorities, obtain leave to place electric conductors below public thoroughfares, subject to such conditions as may be mutually agreed upon, the term of such licence being limited to seven years; or an application may be made to the Board of Trade for a Provisional Order to the same effect, which, when sanctioned by Parliament, secures a right of occupation for twenty-one years. The licence offers the advantage of cheapness, and may be regarded as a purely tentative measure, to enable the firm or company to prove the value of their plant. If this is fairly established, the licence would in all probability be affirmed, either by an engagement for its prolongation from time to time, or by a Provisional Order which would, in that case, be obtained by joint application of the contractor and the local authority. At the time of expiration of the Provisional Order, pre-emption of purchase is accorded to the local authority, against which it has been objected with much force by so competent an authority as Sir Frederick Bramwell, that the conditions of purchase laid down are not such as fairly to remunerate the contracting companies for their expenditure and risk, and that the power of purchase would inevitably induce the parochial bodies to become mere trading associations. But while admitting the undesirability of such a consummation, I cannot help thinking that it was necessary to put some term to contracts entered into with speculative bodies at a time when the true value of electric energy, and the best conditions under which it should be applied, are still very imperfectly understood. The supply of electric energy, particularly in its application to transmission of power, is a matter simply of commercial demand and supply, which need not partake of the character [illegible] large monopoly similar to gas and water supply, and wh[illegible] therefore, be safely left in the hands of individuals, or of lo[illegible]tions, subject to a certain control for the protectio[illegible] interests. At the termination of the period of the Pro[illegible] the contract may be renewed upon such terms and [illegible] at that time appear just and reasonable to [illegible] authority the Board of Trade will be empo[illegible] renewal.

Complaints appear almost daily in the pub[illegible] that townships refuse their assent to applic[illegible] companies for Provisional Orders; but it ma[illegible] of these applications are of a more or less [illegible]

object being to secure monopolies for eventual use or sale, under which circumstances the authorities are clearly justified in withholding their assent; and no licences or Provisional Orders should indeed be granted, I consider, unless the applicants can give assurance of being able and willing to carry out the work within a reasonable time. But there are technical questions involved which are not yet sufficiently well understood to admit of immediate operations upon a large scale.

Attention has been very properly called to the great divergence in the opinions expressed by scientific men regarding the area that each lighting district should comprise, the capital required to light such an area, and the amount of electric tension that should be allowed in the conductors. In the case of gas supply, the works are necessarily situated in the outskirts of the town, on account of the nuisance this manufacture occasions to the immediate neighbourhood; and, therefore, gas supply must range over a large area. It would be possible, no doubt, to deal with electricity on a similar basis, to establish electrical mains in the shape of copper rods of great thickness, with branches diverging from them in all directions; but the question to be considered is, whether such an initiative course is desirable on account either of relative expense or of facility of working. My own opinion, based upon considerable practical experience and thought devoted to the subject, is decidedly adverse to such a plan. In my evidence before the Parliamentary Committee, I limited the desirable area of an electric district in densely populated towns to a quarter of a square mile, and estimated the cost of the necessary establishment of engines, dynamo machines, and conductors, at £100,000, while other witnesses held that areas from one to four square miles could be worked advantageously from one centre, and at a cost not exceeding materially the figure I had given. These discrepancies do not necessarily imply wide differences in the estimated cost of each machine or electric light, inasmuch as such estimates are necessarily based upon various assumptions regarding the number of houses and of public buildings comprised in such a district, and the amount of light to be apportioned to each, but I still maintain my preference for small districts.

By way of illustration, let us take the parish of St. James's, near at hand, a district not more densely populated than other equal areas within the metropolis, although comprising, perhaps, a greater number of public buildings. Its population, according to the preliminary report of the census taken on the 4th April, 1881, was 29,865, it contains 3,018 inhabited houses, and its area is 784,000 square yards, or slightly above a quarter of a square mile.

To light a comfortable house of moderate dimensions in all its parts, to the exclusion of gas, oil, or candles, would require about 100 incandescence lights of from 15 to 18 candle-power each, that being, for instance, the number of Swan lights employed by Sir William Thomson in lighting his house at Glasgow University. Eleven horse-power would be required to excite this number of incandescence lights, and at this rate the parish of St. James's would require $3{,}018 \times 11 = 33{,}200$ horse-power to work it. It may be fairly objected, however, that there are many houses in the parish much below the standard here referred to, but on the other hand, there are 600 of them with shops on the ground-floor, involving larger requirements. Nor does this estimate provide for the large consumption of electric energy that would take place in lighting the eleven churches, eighteen club-houses, nine concert halls, three theatres, besides numerous hotels, restaurants, and lecture halls. A theatre of moderate dimensions, such as the Savoy Theatre, has been proved by experience to require 1,200 incandescence lights, representing an expenditure of 133 horse-power; and about one half that power would have to be set aside for each of the other public buildings here mentioned, constituting an aggregate of 2,926 horse-power; nor does this general estimate comprise street lighting, and to light the six and a half miles of principal streets of the parish with electric light, would require, per mile, thirty-five arc lights of 350 candle-power each, or a total of 227 lights. This, taken at the rate of 0·8 horse-power per light, represents a further requirement of 182 horse-power, making a total of 3,108 horse-power, for purposes independent of house lighting, being equivalent to one horse-power per inhabited house, and bringing the total requirements up to 109 lights = 12 horse-power per house.

I do not, however, agree with those who expect that gas lighting will be entirely superseded, but have, on the contrary, always maintained that the electric light, while possessing great and peculiar advantages for lighting our principal rooms, halls, warehouses, &c., owing to its brilliancy, and more particularly to its non-interference with the healthful condition of the atmosphere, will leave ample room for the development of the former, which is susceptible of great improvement, and is likely to hold its own for the ordinary lighting up of our streets and dwellings.

Assuming, therefore, that the bulk of domestic lighting remains to the gas companies, and that the electric light is introduced into private houses, only, at the rate of, say, twelve incandescence lights per house, the parish of St. James's would have to be provided with electric energy sufficient to work $(9 + 12)\ 3{\cdot}018 = 63{,}378$ lights = 7,042 horse-power effective; this is equal to about one-fourth the total lighting power required, taking into account that the total [illegible]mber of lights that have to be provided for a house are not all used [illegible] and the same time. No allowance is made in this estimate for [illegible]ansmission of power, which, in course of time, will form a very [illegible]pplication of electric energy; but considering that power will [illegible] mostly in the day time, when light is not needed, a material [illegible] plant will not be necessary for that purpose.

[illegible]o minimise the length and thickness of the electric con[illegible] [illegible]uld be important to establish the source of power, as [illegible] be, in the centre of the parish, and the position that [illegible] my mind is that of Golden Square. If the unoccupied [illegible]quare, representing 2,500 square yards, was excavated [illegible]wenty-five feet, and then arched over so as to re[illegible] [illegible]sent ground level, a suitable covered space would be provided for the boilers, engines, and dynamo machines, without causing obstruction or public annoyance; the only erection above the surface would be the chimney, which, if made monumental in form, might be placed in the centre of the square, and be combined with shafts for ventilating the subterranean chamber, care being taken of course to avoid smoke by insuring perfect combustion of the fuel used. The cost of such a chamber, of engine-power, and of dynamo machines capable of converting that power into electric energy, I estimate at £140,000. To this expense would have to be added that of providing and laying the conductors, together with the switches, current-regulators, and arrangements for testing the insulation of the wire.

The cost and dimensions of the conductors would depend upon their length and the electromotive force to be allowed. The latter would no doubt be limited, by the authorities, to the point at which contact of the two conductors with the human frame would not produce injurious effects, or say, to 200 volts, except for street lighting, for which purpose a higher tension is admissible. In considering the proper size of conductor to be used in any given installation two principal factors have to be taken into account; first, the charge for interest and depreciation on the original cost of a unit length of the conductor; and, secondly, the cost of the electrical energy lost through the resistance of a unit of length. The sum of these two, which may be regarded as the cost of conveyance of electricity, is clearly least, as Sir William Thomson pointed out some time ago, when the two components are equal. This, then, is the principle on which the size of a conductor should be determined.

From the experience of large installations I consider that electricity can, roughly speaking, be produced in London at a cost of about one shilling per 10,000 Ampère-Volts or Watts (746 Watts being equal to one horse-power) for an hour. Hence, assuming that each set of four incandescence lamps in series (such as Swan's, but for which may be substituted a smaller number of higher resistance and higher luminosity) requires 200 volts electromotive force and 60 Watts* for their efficient working, the total current required for 64,000 such lights is 19,200 ampères, and the cost of the electric energy lost by this current in passing through 1-100th of an ohm resistance is £16 per hour.

The resistance of a copper bar one quarter of a mile in length and one square inch in section is very nearly 1-100th of an ohm, and the weight is about $2\frac{1}{4}$ tons. Assuming, then, the price of insulated copper conductor at £90 per ton, and the rate of interest and depreciation at $7\frac{1}{2}$ per cent., the charge per hour of the above conductor, when used eight hours per day, is $1\frac{1}{4}$d. Hence, following the principle I have stated above, the proper size of conductor to use for an installation of the magnitude I have supposed would be one of 48·29 in. section, or a round rod 8 in. diameter.

If the mean distance of the lamps from the station be assumed as 350 yards the weight of copper used in the complete system of conductors would be nearly 168 tons, and its cost £15,120. To this must be added the cost of iron pipes for carrying the conductors underground, and of testing-boxes and labour in placing them. Four pipes of 10 in. diameter each would have to proceed in different directions from the central station, each containing sixteen separate conductors of 1 in. diameter and separately insulated, each of them supplying a sub-district of 1,000 lights. The total cost of establishing these conductors may be taken at £37,000, which brings up the total expenditure for central station and leads to £177,000. I assume the conductors to be placed underground, as I consider it quite inadmissible, both as regards permanency and public safety and convenience, to place them above ground within the precincts of towns. With this expenditure the parish of St. James's could be supplied with the electric light to the extent of about 25 per cent. of the total illuminating power required. To provide a larger percentage of electric energy would increase the cost of establishment proportionately, and that of conductors nearly in the square ratio of the increase of the district, unless the loss of energy by resistance is allowed to augment instead.

It may surprise uninitiated persons to be told that to supply a single parish with electric energy necessitates copper conductors of a collective area equal to a rod of eight inches in diameter; and how, it may be asked, will it be possible under such conditions to transmit the energy of waterfalls to distances of twenty or thirty miles, as has been suggested. It must indeed be admitted that the transmission of electric energy of such potential (200 volts) as is admissible in private dwellings would involve conductors of impracticable dimensions, and in order to transmit electrical energy to such distances it is necessary to resort in the first place to an electric current of high tension. By increasing the tension from 200 to 1,200 volts the conductors may be reduced to one-sixth their area, and if we are content to lose a larger proportion of the energy obtained cheaply from a waterfall, we may effect a still greater reduction. A current of such high potential could not be introduced into houses for lighting purposes, but it could be passed through the coils of a secondary dynamo machine, to give motion to another primary machine, producing currents of low potential to be distributed for general consumption. Or secondary batteries may be used to effect the conversion of currents of high into those of low potential, whichever means may be found the cheaper in first cost, in maintenance, and most economical of energy. It may be advisable to have several such relays of energy for great distances, the result of which would be a reduction of the size and cost of conductor at the expense of final effect, and the policy of the electrical engineer will, in such cases, have to be governed by the relative cost of the conductor, and of the power at its original source. If secondary batteries should become more permanent in their action than they are at the present time, they may be largely resorted to by consumers, to receive a charge of electrical energy during the day time, or the small hours of the night, when the central engine would otherwise be unemployed, and the advantage of resorting to these means will depend upon the relative first cost, and cost of working the secondary battery and the

* We presume Dr. Siemens means 60 Watts per lamp.—Eds. Elec. Rev.

engine respectively. These questions are, however, outside the range of our present consideration.

The large aggregate of dwellings comprising the metropolis of London covers about seventy square miles, thirty of which may be taken to consist of parks, squares, and sparsely-inhabited areas, which are not to be considered for our present purpose. The remaining forty square miles could be divided into, say, 140 districts, slightly exceeding a quarter of a square mile on the average, but containing each fully 3,000 houses, and a population similar to that of St. James's.

Assuming twenty of these districts to rank with the parish of St. James's (after deducting the 600 shops which I did not include in my estimate) as central districts, sixty to be residential districts, and sixty to be comparatively poor neighbourhoods, and estimating the illuminating power required for these three classes in the proportion of 1 to $\frac{2}{3}$ to $\frac{1}{3}$, we should find that the total capital expenditure for supplying the metropolis with electric energy to the extent of 25 per cent. of the total lighting requirements would be—

$$20 \times 1 \times 177{,}000 = £3{,}540{,}000$$
$$60 \times \tfrac{2}{3} \times 177{,}000 = £7{,}080{,}000$$
$$60 \times \tfrac{1}{3} \times 177{,}000 = £3{,}540{,}000$$
$$£14{,}160{,}000$$

or, say, £14,000,000, without including lamps and internal fittings, and making an average capital expenditure of £100,000 per district.

To extend the same system over the towns of Great Britain and Ireland would absorb a capital exceeding, certainly £64,000,000, to which must be added £16,000,000 for lamps and internal fittings, making a total capital expenditure of £80,000,000. Some of us may live to see this realised, but to find such an amount of capital, and, what is more important, to find the manufacturing appliances to produce work representing this value of machinery and wire, must necessarily be the result of many years of technical development. If, therefore, we see that electric companies apply for Provisional Orders to supply electric energy, not only for every town throughout the country, but also for colonies and for foreign parts, we are forced to the conclusion that their ambition is somewhat in excess of their power of performance; and that no Provisional Order should be granted except conditionally on the work being executed within a reasonable time, as without such a provision the powers granted may have the effect of retarding instead of advancing electric lighting, and of providing an undue encouragement to purely speculative operations.

The extension of a district beyond the quarter of a square mile limit would necessitate an establishment of unwieldly dimensions, and the total cost of electric conductors per unit area would be materially increased; but independently of the consideration of cost, great public inconvenience would arise in consequence of the number and dimensions of the electric conductors, which could no longer be accommodated in narrow channels placed below the kerb stones, but would necessitate the construction of costly subways—veritable *cava electrica*.

The amount of the working charges of an establishment comprising the parish of St. James's would depend on the number of working hours in the day, and on the price of fuel per ton. Assuming the 64,000 lights to incandesce for six hours a day, the price of coal to be 20s. a ton, and the consumption 2 lbs. per effective horse-power per hour, the annual charge under this head, taking eight hours' firing, would amount to about £18,300, to which would have to be added for wages, repairs, and sundries, about £6,000, for interest with depreciation at seven and a-half per cent., £13,300, and for general management, say, £3,4000, making a total annual charge of £41,000, or at the rate of 12s. 9½d per incandescence lamp per annum. To this has to be added the cost of renewal of lamps, which may be taken at 5s. per lamp of 16 candles, lasting 1,200 hours, or to 9s. per annum, making a total of 21s. 9½d. per lamp for a year.

In comparing these results with the cost of gas lighting we shall find that it takes five cubic feet of gas, in a good argand burner, to produce the same luminous effect as one incandescence light of 16 candle-power. In lighting such a burner every day, for six hours on the average, we obtain an annual gas consumption of 10,950 cubic feet, the value of which, taken at the rate of 2s. 8d. per thousand, represents an annual charge of 29s., showing that electric light by incandescence, when carried out on a large scale, is decidedly cheaper than gas lighting at present prices, and with the ordinary gas burners.

On the other hand, the cost of establishing gas works and mains of a capacity equal to 64,000 argand burners would involve an expenditure not exceeding £80,000, as compared with £177,000 in the case of electricity; and it is thus shown that although it is more costly to establish a given supply of illuminating power by electricity than gas, the former has the advantage as regards current cost of production.

It would not be safe, however, for the advocates of electric lighting to rely upon these figures as representing a permanent state of things. In calculating the cost of electric light, I have only allowed for depreciation and 5 per cent. interest upon capital expenditure, whereas gas companies are in the habit of dividing large dividends, and can afford to supply gas at a cheaper rate, by taking advantage of recent improvements in manufacturing operations, and of the ever-increasing value of their by-products, including tar, coke, and ammoniacal liquor. Burners have, moreover, been recently devised by which the luminous effect for a given expenditure of gas can be nearly doubled by purely mechanical arrangements, and the brilliancy of the light can be greatly improved.

On the other hand, electric lighting also may certainly be cheapened by resorting, to a greater extent than has been assumed, to arc lighting, which, though less agreeable than the incandescence light for domestic purposes, can be produced at less than half the cost, and deserves on that account the preference for street lighting, and for halls, in combination with incandescence lights. Lamps by incandescence may be produced hereafter at a lower cost, and of a more enduring character.

Considering the increasing public demand for improved illumination, it is not unreasonable to expect that the introduction of the electric light to the full extent here contemplated, would go hand-in-hand with an increasing consumption of gas for illuminating and for heating purposes, and the neck-to-neck competition between the representatives of the two systems of illumination, which is likely to ensue, cannot fail to improve the quality, and to cheapen the supply of both, a competition which the consuming public can afford to watch with complacent self-satisfaction. Electricity must win the day, as the light of luxury; but gas will, at the same time, find an ever-increasing application for the more humble purposes of diffusing light.

In my address to the British Association I dwelt upon the capabilities and prospects of gas, both as an illuminant and as a heating agent, and I do not think that I was over sanguine in predicting for this combustible a future exceeding all present anticipations.

I showed that if supplied specially for the purpose, it would become not only the most convenient, but by far the cheapest form of fuel that can be delivered to our towns. Such a general supply of heating separately from illuminating gas, by collecting the two gases into separate holders during the process of distillation, would have the beneficial effects—

1st. Of giving to lighting gas a higher illuminating power.

2nd. Of relieving our towns of their most objectionable traffic, that in coal and ashes.

3rd. Of effecting the perfect cure of that bugbear of our winter existence—the smoke nuisance.

4th. Of largely increasing the production of those valuable byeproducts, tar, coke, and ammonia, the annual value of which already exceeds by nearly £3,000,000 that of the coal consumed in the gas works.

Dr. Siemens concluded his able discourse by remarking that he considered the Society of Arts to be the proper body to thoroughly examine the question of the application of gas and electricity for lighting purposes, &c., and that he would be well pleased if he could be instrumental in engaging the Society's attention to such an important matter.

SNELL'S PATENT ELECTRIC ARC LAMP.

In this lamp a single electro-magnet in a derived circuit is used to make and regulate the arc, and all rack or clockwork dispensed with.

As can be seen from the diagrams, a brake attached to a soft iron core is actuated by the magnetism in the core to regulate the descent of the enclosed rod which forms the upper carbon-holder, the downward motion of the core due to the action of the solenoid upon it being resisted by the spring beneath.

The lower carbon-holder is held by an insulated strap to which one terminal is attached, the other terminal being on the bobbin of the solenoid and projecting through the case which encloses and protects all the mechanism.

As a means of reducing the resistance the upper carbon is fed by two copper strips which touch it near its lower end; they are gently pressed against the carbon by the hinged weights attached to the wires from the base plate above, and are easily separated by the carbon-holder when the rod has descended sufficiently.

The brake is shown in fig. 2, and an enlarged section is given in fig. 3. It consists of a brass arm on each side of the core with a soft iron armature forming the connection between them at the back, these arms being pivoted to the core and carrying a brake-block opposite the armature. This block passes through a slot in the core and presses upon the enclosed rod or carbon-holder, keeping it in position, so that the movements of the rod and carbon are (so far) the same as those of the core itself. A weighted arm is screwed through the armature which allows, by the adjustment of the weight, the regulation of the descent of the carbon and rod with simplicity and extreme delicacy, and also serves to regulate the play between the armature and the core.

When the lamp is in action, any increase in the normal distance between the carbons increases the current in the solenoid, or shunt circuit, which, acting on the core causes a more powerful attraction between that and [illegible] armature, the result being that the pressure of [illegible] block upon the rod is lessened, and the rate of d[illegible] rod is augmented.

This brake being controlled by magnet[illegible] gives great sensibility, and a steady and [illegible] of the rod should be insured.

The antagonism between the sprin[illegible]

adjust the arc, for if in any case the feed should be excessive, the resulting lessening of the power of the solenoid would cause firmer application of the brake, and lifting of the core and rod by the spring, until the right amount of separation between the carbons was again attained.

Should the light be accidentally extinguished, the power of the solenoid being increased would cause the release of the brake and descent of the core, until contact was again established, when the immediate rising of the core and rod (for the brake would then be applied) by the action of the spring would cause the normal distance to be again attained.

FIG. 1.

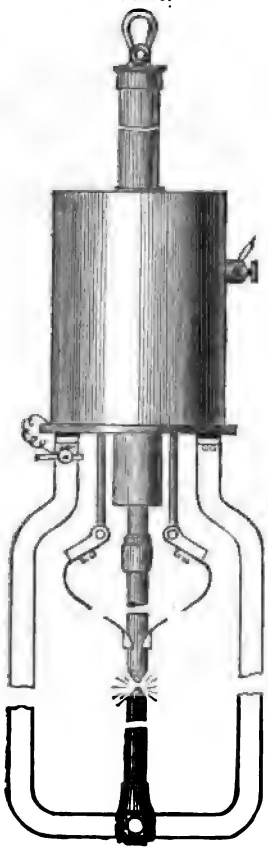


FIG. 2.

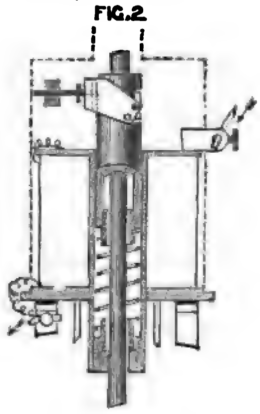
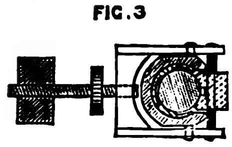


FIG. 3



From the above it will be seen that by means of the weight on the arm attached to the brake armature, the position of the carbons is regulated in such a manner as to guarantee, in the inventor's opinion, a steady and very certain action, whilst liability to derangement is reduced to a minimum.

Any number of lamps may, of course, be placed in one circuit, according to the electromotive force of the generating machine, and the lamp is said to work with currents of very different intensities without changing any part of its mechanism.

It is simple, and apparently reliable; sensitive and easy of adjustment; and certainty of action might, therefore, be guaranteed with safety.

The vibrations which would be produced by alternating currents would be especially favourable to its working.

We have not yet seen this lamp in operation, but we have no reason to doubt its efficiency, and we congratulate Mr. Snell on what we believe to be his first inventive effort in electric lighting apparatus.

One advantage in Snell's lamp is the absence of any coil in the main circuit to absorb a part of the current passing between the terminals, and as almost every other arc lamp has such a coil in addition to the shunt electro-magnet or solenoid this advantage is a material one.

[illegible] cost should be very slight compared with many others [illegible]esent in use, and therefore its selling price ought [illegible]ly to be equally low. We hope shortly to see this [illegible] action, when we shall again refer to it. As far as [illegible]ge at present Mr. Snell appears to have produced [illegible]amp of the kind as can well be expected, and [illegible] glad to hear of its successful operation in [illegible]ing. The invention is patented in England and abroad, but we do not know what special claims are made.

Now that so many arc lamps have been brought forward, one would almost think that inventors should turn their thoughts in other directions, but as Dr. Siemens very truly remarked in his address to the Society of Arts, which we publish in this issue, if the greatest economy is wished for from the electric light then arc lamps must be employed, and it may be inferred that the learned doctor does not agree with the opinion now openly expressed by many that electric lighting by means of arc lamps has had its day. Therefore, as far as arc lights go we may expect to see some of those at present in use superseded by others of a more simple, *cheap*, and reliable character, and Mr. Snell's simple lamp, which may probably be rendered still more so, appears to promise well.

DETECTION BY ELECTRICITY OF THE ANNUAL CULMINATIONS OF THE SOLAR INFLUENCE ON ORGANISMS.*

By NILS KOLKIN.

It came to my notice several years ago that, if one end of a hair or thread were tied to a watch-key or some similar object, and a person, seated comfortably before a table, with his elbow resting on the same, took hold of the other end, so as to raise the key from the table and keep it suspended, it was impossible to keep it still, in spite of all precautions. Oscillations would begin which, if the hands were warm, would attain great violence. If the key were permitted to strike against anything except glass, silk, dry rusty iron, or other bad conductors of electricity, the oscillations would be interrupted by short pauses occurring at regular intervals; and the strokes between these pauses would correspond with the age of the hair, or, more correctly, their number would show how many years old the person was when he lost it. I understood that these oscillations were caused by electricity; that the key was positively or negatively charged and repelled by the arm and hand, which were similarly charged.

I have since investigated this phenomenon, as much as my time has allowed, and I shall here carefully give the results of my experiments. I have also substituted electricity from other sources than that used in those primitive experiments, and, when I have not met the same success, it is due to the fact that I am not a practical electrician.

There is no known principle that accounts for the pauses in the oscillations. But the explanation seems to be that—*When any organic substance is continually charged by positive or negative electricity, and discharged in rapid succession, under certain circumstances, the substance itself, and things in contact with it, will, after a certain number of discharges, for a moment become non-conductors; and the number of those discharges will correspond to the age of the vegetable or animal from which the substance is derived.* I say "under certain circumstances," for I do not know whether repulsion and attraction is necessary or not. My experiments have always been with a suspended key, except with a metallic spring, placed horizontally, which is virtually the same thing. The resistance to electricity during the pause is, indeed, very slight; it does not take a very powerful charge to overcome it. The weaker the supply of electricity, the better it is. Shortening the fibre by which the key is suspended will give the best results. It will make the oscillations more rapid, and they ought to be rapid enough to make it necessary to count them by twos, for the pause will thus be better noticed.

All organic substances possess this age-telling property, except absolute non-conductors, as silk. If substances of different ages are used together the age of the oldest only is shown. This fact makes it possible to find the age of substances of all forms, even with a suspended key. A fibre of an annual plant may be used and any dry substance tied in it; in case of liquids, the fibre may be satu-

* American Association for the Advancement of Science.

rated with them. Liquids are good conductors and must be guarded against. The smallest particle of juice, or sweat, on anything, when of higher age, will show its presence.

The age of a substance here must not be taken to mean the time it has existed as such, but that age which the vegetable or animal that may be its source had when its connection with that source was severed. A leaf may be two months old, but it shows the age of the tree; a drop of milk, that of the cow. I have permitted myself to call this "organic age;" but as we have nothing to do with any other kind here the word "age" must always be taken in this sense. Any part of an organism, any seed, fruit, secretion, or any part or product whatever, has the same organic age as its source. The age of vegetables counts from the time they sprang from seed. Those propagated from roots or cuttings have the age as the original. A potato showed between 800 and 900 years. The age of animals corresponds with what is commonly termed so; but new-born young have the same organic age as the mother.

This age-telling property of organisms does not seem to be destroyed by time. To what extent chemical changes does it I cannot say. Considerably decayed wood retains it. Some kerosene, which caused the discovery of the age-telling property of liquids, showed constantly eight years; but this might have been due to some foreign substance.

It is, of course, plain to all, that the interruption of the oscillations has nothing to do with our civil year as it is divided off in the almanac, but with a natural year. A natural year in our zone consists of an increase, a culmination, and a decrease of the solar influence. It is the number of those annual culminations to which an organism has been exposed during life that is shown. In case of annual plants, grown during the increase or decrease, they will show a year though they have not been exposed to the maximum influence of the sun. So with animals less than a year old. The oscillations generally cease very abruptly, but when a considerable fraction of a year remains uncounted, there is often a gradual subsidence into a pause. How it is with organisms under the equator, where the passes twice a year, I do not know. But a knowledge would throw some light on this question.

That the sun has great influence on plants all know; but that it should have so great an influence on animals that each annual increase, culmination, and decrease of that influence should be registered in their organisms, will seem to many a great heresy. The sun, however, has more power than is generally supposed. Many persons will know that they do not feel the same under its decrease and increase. They do not seem to be the same persons in the autumn and in the spring, everything else being equal. The influence of the sun pervades all nature, and reaches life, both animal and vegetable, in recesses completely hidden from its rays.

EBEL'S PATENT RELAY.

The advantages which are claimed for this relay, are:— 1. Simplicity. 2. Compact arrangement of the whole, and consequently the cheapness with which it may be manufactured. 3. Extreme sensitiveness.

Fig. 4 is a general view of the instrument, and figs. 1, 2, and 3, show the arrangement of the same. In fig. 3, *a* is a

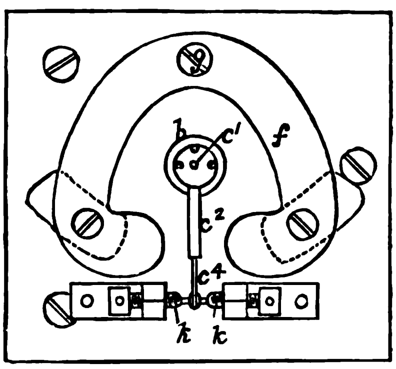


Fig. 1.

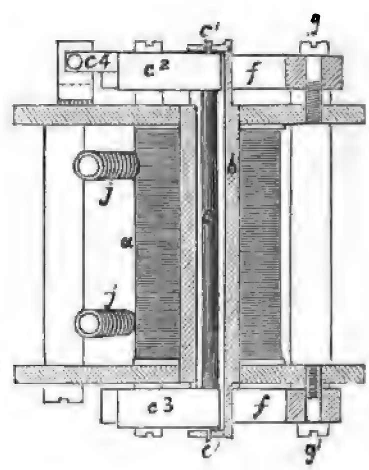


Fig. 3.

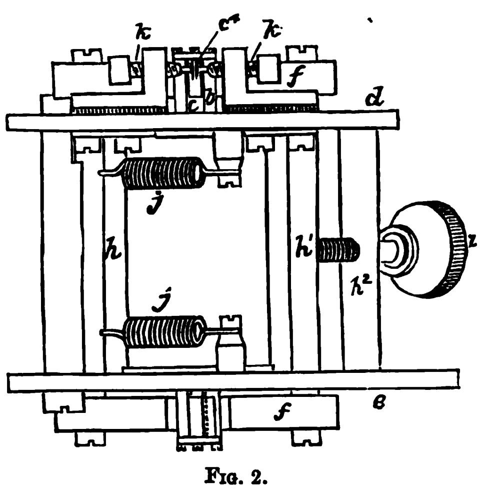


Fig. 2.

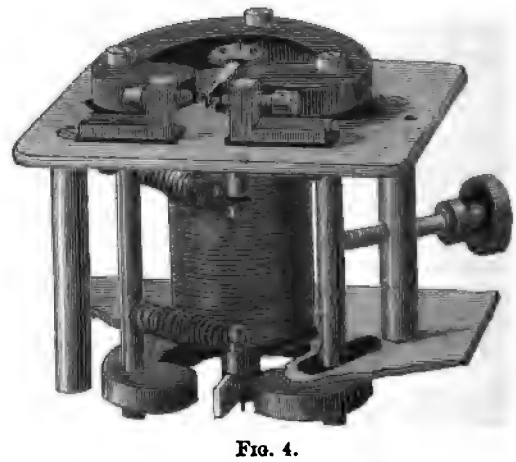


Fig. 4.

bobbin of insulated wire, in which is placed a soft iron compound core consisting of b, c, c_2, and c_3. b is a tube, in the centre of which is placed a rod, or bar, c (made of extreme lightness), oscillating freely upon pivots in c_1 and c_1. On each end of rod, or bar, c_1, are attached prolongations which constitute armatures, c_2 and c_3. ff are permanent horse-shoe magnets connected together by rods of non-magnetic metal, h and h_1 (fig. 2), and pivoted at g and g_1 (fig. 3). The horse-shoe magnets, ff, are so arranged with reference to the armatures, c_2, c_3, that the latter can move to and fro between the poles of these magnets. In fig. 2, j and j are spiral springs attached to a rod, h, and plates, d and e, which tend to constantly draw the horse-shoe magnets in one direction. On the rod h_2 are placed adjusting screws, i, by which the position of the horse-shoe magnets can be regulated. To limit the play of the armatures, c_2 and c_3, a metal piece, c_4, is attached to c_2, the movement of which is controlled by two insulated contact screws, k, k (fig. 1).

It will be seen that the whole arrangement of the Ebel relay is very compact, and as the moving parts are very light, and the amount of iron to be rendered magnetic by the working current very small, the probabilities of its working at a high speed are very great.

The Post-office standard relay will give perfect signals when worked with one-third of a milliampère of current (one Daniell cell through 3,000 ohms, approximately), and we think that the Ebel relay should do as equally well as this.

Altogether the advantages which the inventor claims for his relay are not, we consider, exaggerated.

RATIONAL CONCEPTION OF THE NATURE AND THE PROPAGATION OF ELECTRICITY.

DEDUCED :—1. FROM THE CONSIDERATION OF THE POTENTIAL ENERGY OF ETHEREAL MATTER ASSOCIATED WITH PONDERABLE MATTER. 2. FROM THE MODE OF PRODUCTION AND OF TRANSMISSION OF WORK ACCOMPANYING THE VARIATIONS OF THIS ENERGY. (*Continued.*)

By M. A. LEDIEU.

VI. Our inductions may be summed up thus :—

1. The complete molecules of every body must be regarded each as an aggregate of ponderable atoms, and of ethereal atoms, both vibrating in relation to a system of axes passing by the centre of gravity of the aggregate, whilst the system itself oscillates with reference to an imaginary solid concerning the centres of gravity of all the molecules of the body. The ethereal atoms of each molecule form to a greater or less extent a sort of atmosphere around its ponderable nucleus. This atmosphere is independent of the cosmic ether which plays in the molecular interstices of the body.

2. The ponderable atoms have, by pairs, their mutual actions equal to $m\,m'\,f\,(l)$; $m\,m'$ representing the masses, and l the distances.

3. The ethereal atoms have all an identical mass, μ, excessively small, with reference to those of the ponderable atoms. The expression of their mutual dynamic connection is $\mu^2\,\phi\,(l)$; and the law of the reciprocal actions which associate them to the ponderable atoms is represented by $m\,\mu\,\mathrm{F}\,(l)$. By reason of the smallness of $m\,\mu$, the function $\mathrm{F}\,(l)$ must, at least for certain values of l, be considerable with reference to the two other functions of distance above $f\,(l)$ and $\phi\,(l)$. This capital supposition is necessary to explain the powerful effects which are produced between the ponderable matter and the ethereal matter.

4. Each complete molecule has constantly its physico-chemical modality mechanically specified by its *actual* energy and its *total potential* energy.

The former A of these energies is of the known form,

$$(1) \qquad \mathrm{A} = \Sigma\, m\, v^2 + \Sigma\, \mu\, v_1^2,$$

v and v_1 being the velocities at once vibratory and oscillatory, of the different kinds of atoms, with reference to the imaginary solid above mentioned, or their residual velocities with reference to the rest or the motion of the whole of the body.

On its part, the *total potential* energy, P, of the complete molecule, has its value constituted by the aid of functions of forces, and represented by

$$(2)\left\{\begin{aligned} \mathrm{P} = \{\mathrm{C}_1 - \textstyle\int[\Sigma\, m\, m'\, \mathrm{F}\,(l)\, d\, l]\} \\ + \{\mathrm{C}_2 - \textstyle\int[\Sigma\, \mu^2\, \psi\,(l)\, d\, l] - \int \\ [\Sigma\, m\, \mu\, f\,(l)\, d\, l]\} \end{aligned}\right.$$

The constants, C_1 and C_2, are such that the smallest possible value of P may $= o$, at the same time that each term between brackets is itself null.

If we wish to have the potential energy of an entire body, we must consider correlatively with the P of each molecule a certain sum, $\Sigma\pi$, of functions of forces, each corresponding to the reciprocal actions between each atom of the molecule in question and all atoms of the surrounding molecules.

Hence we have for this energy—

$$(3) \qquad p = c' + \Sigma\,\mathrm{P} - \tfrac{1}{2}\,\Sigma\,\Sigma\,\pi.$$

The constant, c, should be such that when combined with the constants of P it annuls the smallest possible value of p.

VII. The preceding hypotheses and formulæ being well understood, we regard the temperature of each complete molecule of a body as characterised by its actual energy. In the same manner the chemical and the latent thermic and electric state of the molecule is specified as a whole by its total potential energy, P. But in detail its chemical and latent thermic condition appears from the first of the terms between brackets in the expression for P. We call this first term the *ponderable* potential energy of the entire molecule. On the other hand, the electric condition depends on the second of the terms in question. This second term of the expression of P measures the potential energy of the ethereal matter associated with the ponderable matter of the molecule.

Otherwise the physico-chemical modality of the totality of a body is principally specified by the modalities of its several molecules. It is further affected by the respective situations of the molecules for these situations in the term π of the formula (3), and tells principally upon the latent heat of the system.

In the foregoing we have implicitly considered the instantaneous values of the various energies studied. Let us now attend to their successive values. When the successive values attached to each molecule of a body remain constant or oscillate slightly around a fixed mean we say that the physico-chemical modality of the body is permanent. This permanence may be either uniform or not according as there is an equality or inequality of the values in question for all the molecules of the body. The first case requires that the body should be so isolated as to escape the atomic forces of every strange system. The second case is met with when these forces make themselves felt and exert themselves according to a certain correlation. When this correlation is deficient the physico-chemical modality of the body becomes variable. In general the variability affects the modality of each molecule; there is besides a radical modification of this latter modality if chemical phenomena occur.

VIII. In fine, electricity, like heat and light, cannot be regarded as a special agent ruled by an especial mechanics. As a phenomenal cause, it is simply the potential energy of the ether associated with ponderable matter, especially in the form of atmospheres surrounding the molecules. This sort of energy, with which no one hitherto seems to have engaged himself, includes the secret of all electrical effects. Its variations owe their mechanical power to the greatness of $\mathrm{F}\,(l)$, pointed out in VI., which compensates for the common mass, μ, of the atoms of ether. It has, as an appendage, the portion of the potential energy of the ponderable matter which constitutes principally the latent heat, in the same manner as the sensible heat reveals the residual *vis viva* of the ponderable and ethereal atoms, and as the radiant light and heat reside in the vibrations of the free cosmic ether undulating across the celestial spaces or through the molecular interstices of ponderable bodies.

When a body is brought in contact with one or with several other systems so that it feels their influence in one of the manners indicated in VII., a series of modifications of the various energies may ensue, and especially a variation of the ethero-ponderable energy, producing work in the appearance of electricity, including discharges. This last variation may ensue in part from a change in the number of the ethereal atoms constituting the molecular atmospheres, either borrowing from or restoring to the inexhaustible stock which forms the cosmic ether. The said functions are in principle concomitant.

IX. Let us now study the propagation of electricity according to our views. To this end we will first discuss the transmission of heat according to thermodynamics.

There mechanical work is propagated, and there is constantly a difference between place and place in the thermic condition of the body with local permanence if the transmission is regular. In every case the body is merely a simple conductor of energy, and the phenomenon is only effected in virtue of a difference $(\mathrm{A}_2 - \mathrm{A}_1)$ between the actual energies A_2 and A peculiar to each molecule by groups

to the parts of the conductor in contact, the one with a hot and the other with a cold system.

The theory of Fourier associates itself completely to our new interpretation. It is sufficient for this purpose to join to the special hypotheses of this theory the possibility of considering certain differences as infinitely small ones of the first or the second order.

What we have just said concerning the transmission of heat is applicable, word for word, to the propagation of electricity. We need only substitute the consideration of the potential ethero-ponderable energies of successive molecules for the consideration of their actual energies. The electric current consists in a simple transport of mechanical work, w, and the fall of the electric potential corresponds to a difference $(p_2 - p_1)$ between the potential ethero-ponderable energies, p_2 and p_1, proper to each molecule per group in two opposite parts of the conductor.

X. The general mode of the apparent production and transmission of electricity, which we have just indicated, is merely a particular case of a much larger question and which forms an indispensable corrollary of the great law of the conservation of energies. We wish to speak of the transformation and propagation of energies in the most universal case. From the transmission of the work of total movement through the supposed rigid parts of a piece of mechanism we must conceive that this work is propagated only by the intervention of the ponderable potential energies of the said parts, giving rise to phenomena of elasticity.

On the other hand, in the well-known experiment of a series of ivory balls suspended to the same horizontal rod, the *vis viva* of the total movement of the first ball is transmitted to the last, by the aid of the ponderable potential energies of all the intermediate balls. These, as it is known, remain as a whole at rest, and form thus a true conductor of work. There is here a striking analogy with that which takes place according to our theory in the propagation of electricity. It is sufficient to reduce, in thought, the balls to simple molecules with an ethereal atmosphere, and to imagine that the potential ethero-ponderable energies are alone in play.

XI. According to us the only electric magnitude which has a real mechanical signification is the work of the current, w. But, according to III. and IX., we have for $t = \mathrm{t}$, and putting $\omega = \omega_m : \omega_s$—

$$e_s = \sqrt{p_2 - p_1} \times \omega_s, \; i_s = \frac{\sqrt{\mathrm{W}}}{\sqrt{r_s}}$$

$$e_m = \sqrt{p_2 - p_1} \times \omega_m, \; i_m = \frac{\sqrt{\mathrm{W}}}{\sqrt{r_m}}$$

Hence the intensity of the current and the electromotive force of the circuit will be nothing but the roots of certain quantities of mechanical work, multiplied or divided by certain co-efficients.

With these interpretations of the electric magnitudes, i, e, r, we may preserve the greater part of the formulæ already acquired; the experimental establishment and verification of these formulæ merely need to be dealt with according to their true mechanical signification—*Comptes Rendus*, XCV., p. 753.

THE TRANSMISSION OF POWER TO A DISTANCE, AND THE EXPERIMENTS AT MIESBACH-MUNICH.

The exaggerated figures which have been given by M. Marcel Deprez to estimate the *electric return* in his experiments on the transmission of power between Miesbach and Munich have not been accepted without protestation by a certain number of scientific periodicals; these protestations are produced also in the midst of the Scientific Societies: at the Académie des Sciences, at the Société Française de Physique, by M. Cabanellas (see the Elec-Review of last week); and at the Society of Engineers and of Electricians, by Professor the meeting of the 9th November.

M. Marcel Deprez thought proper to reply to certain objections, and to prevent others, by addressing a letter to *La Lumière Electrique*, a letter inserted *in extenso* in the November 11th number of that journal.

M. Marcel Deprez answers indeed victoriously certain puerile objections, but he leaves completely in shadow and silence those which it was most difficult and, consequently, most necessary to contest and reduce to nothing.

According to M. Marcel Deprez's letter, Professor Kittler would have measured, at his request, the fraction of the current lost along the line before he determined to make this difficult experiment. According to M. Kittler, the intensity of the current being represented by 1 at Miesbach, was still higher than 0 98 at Munich.

Here is an ambiguity which leads to singular mistakes. If the insulation experiments of M. Kittler were made *before* M. Marcel Deprez determined to make the experiment on the transmission of power, how could one conclude from it that the loss upon the line was only two per cent. during the experiment with currents of several thousand volts? This result is the less acceptable as M. Marcel Deprez admits in another part of his letter that it rained almost without interruption for twelve days at the time of the first experiment. The return was measured by taking directly the electromotive force of the machines and the intensity of the current at Miesbach and at Munich; its value is *sensibly* found in agreement with that derived from the relation of the speeds, which shows that the loss of the line was inappreciable. It cannot be too much regretted that M. Marcel Deprez neglected, in his long letter, to give us these interesting figures; it is certain that they would have silenced all discussion, and that they alone would give the true value of the electric return of 60 per cent. so much disputed. By accepting the figures given by the *Bulletin de la Compagnie Internationale des Téléphones*, in which all loss by conductors is ignored, the difference of potential at the terminals of the generator is 2,100 volts and the current 0·5 ampères.

The electric energy furnished by this machine, disposable in the external circuit, is equal to

$$\frac{\mathrm{EI}}{9{\cdot}81} = \frac{2{,}100 \times 0{\cdot}5}{9{\cdot}81} = 107 \text{ kilogrammetres per second.}$$

There may be added to this figure that of the heating of the generator: resistance, 470 ohms; current, 0·5 ampères. Its value in kilogrammetres is—

$$\frac{\mathrm{RI}^2}{9{\cdot}81} = \frac{470 \times 0{\cdot}5^2}{9{\cdot}81} = 12 \text{ kilogrammetres per second.}$$

The generator transforms, therefore, into electricity, a power

equal to $107 + 12 = 119$ kilogrammetres per second.

And as one obtains only 38 at its destination, the return does not exceed

$$\frac{38}{119} = 32 \text{ per cent.}$$

This theoretical inference seems in accordance with one figure given by M. Marcel Deprez, who agrees that the estimated industrial return does not exceed 30 per cent.

We do not know whether the figures given by the *Bulletin de la Compagnie Générale des Téléphones* are correct or not, whether they emanate from the Commission of Experiments, or from interested persons, but whatever be their origin, we should like to be certain as to their value. Ten lines of volts and ampères, very accurately measured, would have assured us better than M. Marcel Deprez's letter of four columns, filled more with assertions than figures. When shall we have the Official Report?

E. HOSPITALIER.

An Electrical Tramway.—We notice that experiments have recently been privately made on the Giant's Causeway-Portrush tramway. It is said that several runs were tried of over a mile distance, the speed attained being ten miles an hour. We do not know how many carriages were used, or what weight was carried. The motion is described as being pleasant and without vibration.

TO CORRESPONDENTS.

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CORRESPONDENCE.

PROVIDING EARTH CONNECTIONS FOR ELECTRIC CURRENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Abstract of Published Specifications, 1367, by A. E. Dolbear, in your issue of November 11th. As far as I understand this the claim is for a system of connecting "earth plates" (called here "ground") that has been in constant practice these last ten years. When the railway block system came in force eight to ten years ago, it was the order of the day then to provide a separate "earth" for each block wire. You will readily believe that if more than one block wire was on the same "earth" any accident occurring to it might lead to serious consequences, so it was necessary then in practice to find perfect "earth" for each wire separately. To do this and get "earths" of equal potential it was sometimes necessary to run a wire over a mile in length. But it would now seem that it was left for the inventive masters of this year to apply for letters patent for so common a practice.

As far as telephone companies are concerned I fear the finding of separate "earth" for each wire would be as difficult from a financial point of view as it would be to *insulate* them in *the same water* from an electrical point of view. Query: can it be said of two plates conveying an electric current into the same water that they are insulated from each other by being simply separated? If so what becomes of the theory lately made so much of, viz., signalling through water without the aid of wire.

I may just add that at present I am intimately connected with an "earth" that is not directly in the water nor the sea, on which there are about 400 different telephones connected with wires of all lengths from 100 yards to 25 miles, and working perfectly. Yours truly,

DENSHIN.

ON INDUCTION.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—In your issue for July 22nd, 1882, is given an account of the very interesting results of Mr. Willoughby Smith on "Induction." In some experiments performed last spring regarding the effect of interposed plates of metal on the inductive action between two parallel circuits, I noticed one or two facts which are perhaps worth mentioning in connection with Mr. Smith's results. It appears from the tables given that the "per cent. of inductive energy intercepted," as it is termed, increases with the rapidity of reversal of the current. These results, as shown by the use of the galvanometer, explain an interesting fact noticed when a magneto-telephone is placed in the secondary coil, and a circuit-breaker, as the vibrating reed of an induction coil, in the primary circuit. Under these circumstances the introduction of a plate of metal between the two parallel coils causes, as is well known, a considerable diminution in the intensity of the sound produced; but it is also noticeable that the harsh higher partials of the tone caused by the interrupter disappear far more completely than the lower overtones and the fundamental. The same effect may be noticed with the voice if a microphone transmitter is substituted for the vibrating reed.

I am inclined to think that in the closing paragraph of the article referred to you underrate the value of lead in diminishing induction effects. If a plate of lead is placed between two parallel coils, with a battery and circuit-breaker in one circuit, and a magneto-receiver in the other, there is a very noticeable diminution of sound produced by the lead plate; although this is much less than with sheets of brass or copper, or than when a completely closed spare circuit of copper wire is placed within or between the two coils. Moreover, experiments with an underground cable, constructed by the American Bell Telephone Company for experimental purposes, show that the lead pipe in which it is enclosed exerts a large effect in diminishing induction from wire to wire.

The comparative inefficiency of the tin, or lead-foil covering frequently used to envelope separate and parallel telephone wires, must arise largely from the small mass, and consequent high resistance of the foil. The application of the foil arose at first, I imagine, from the idea that electro-dynamic induction, like ordinary electro-static induction, could be avoided by separating the two circuits by a completely closed wall of any conducting substance, without much reference to its resistance; so that a telephone wire could be entirely protected by the same means used to protect an electrometer from inductive disturbances. But although with a sheet of no resistance this would be the case, it is practically far from true when thin tin-foil is used. With the rapidly-varying telephonic currents, the resistance of the sheet becomes a very important factor, and even a spare circuit-wire forms a better "induction shield" than the thin foil coating.

CHAS. R. CROSS.

Massachusetts Institute of Technology, Boston,
October 30th, 1882.

DANGERS OF ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—So much has been written on the above subject, and such fears have been engendered in the minds of many who otherwise would be glad to adopt a system of electric lighting, that a few remarks tending to allay such fears, may not be deemed unworthy of a space in your valuable journal.

That there is some danger is as undeniable as that equal, if not greater, danger exists in the use of any other illuminant; but I maintain that with the most ordinary care, and under the supervision of a *practical* electrician, the danger attending electric lighting is far less than that attending any other system of lighting, and where danger exists the fault would lie with the engineer.

I have seen many installations in London and in the provinces, and have been surprised at the rough and careless manner in which the wires have been run, and still more surprised to find that the engineer could see no faults in the work nor recognise sources of danger. Herein lies one of the chief sources of danger in electric lighting: the employment of men who have no practical experience of wire running and joint making, &c. An electrical engineer should be a man who, with a good knowledge of electrical science, can not only supervise but who can give such prac-

tical instruction (by personal illustration) to those under him that there can be no chance of careless work.

Given such a man and the danger absolutely ceases to exist.

The public have really nothing to fear; the majority of the accidents that have been brought so prominently before them have been caused by bad workmanship or palpable carelessness consequent on the introduction of a new scheme and a limited knowledge of details. I cannot but think that the many letters which have from time to time appeared on this subject have not been prompted by entirely disinterested motives.

I am confident that electricians will agree that there are few, if any, instances on record of damage done or life lost by electric lighting which cannot be traced to inferior construction, and the public may rest well assured that the various companies are now fully aware of the importance of giving attention to the smallest detail of construction and will take every precaution to guard against the slightest chance of danger to life and property.

Yours faithfully,
YOSHI.

November 20th, 1882.

BERTHOULD, BOREL AND COMPANY'S ELECTRIC CABLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—With reference to the article on these cables in your issue of the 11th instant, will you permit us (as the sole representatives of the manufacturers in this country) to offer the following remarks.

The manufacturers have introduced considerable changes in their process of late; and their cables widely differ from those you speak of as Mr. Marshall's. Paraffine is now no longer used, but instead a new insulating compound is employed. Further, the lead tube is not first formed, and then the wire drawn into it—as you describe by Marshall's process—but the lead-covering and insulating material are put on simultaneously and automatically.

With regard to time-tests, we can point to the fact that two years ago a large quantity was placed in the marshy borders of the lake at Neufchâtel, and though covered only with a single sheathing of lead, has not deteriorated in the least during all that time, and tests show the insulation to be as perfect now as on the day the cables were laid. So confident are we of the durability of Messrs. Berthould, Borel and Company's cable that we are willing to guarantee it for any reasonable number of years.

Yours faithfully,
J. T. ZORN,
Acting Manager,
The Electrical Trading Company (Limited).

[Our correspondent does not appear to have read carefully our remarks as applied to Mr. Marshall. The Windsor Park experiment referred to in our article proves most conclusively that under certain conditions a lead protecting covering would undoubtedly decay, and we cannot see that there is any peculiarity in the Berthould-Borel cables which could absolutely prevent such deterioration.—EDS. ELEC. REV.]

QUERIES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I should be much obliged if, in the columns of your valuable journal, you could kindly answer the following questions:—

What is the distance between the poles on a G. P. O. telegraph line on which a twisted telephone circuit is arranged? In which book can I fully study the laws which govern the lines of magnetic force and the theory of dynamo-electric machines based on these lines?

In explaining the induction of a conductor traversed by a galvanic current upon a neighbouring closed circuit, most text-books, as far as my knowledge extends, state that in the latter *one* induced current is produced. In order to -te induction from a telegraph wire on a telephone complete metallic circuit is used, and induction is d by *two* induced currents in the telephone loop which neutralise each other—one current in each wire—being both of the same direction relative to the primary, but of opposite direction relative to each other. How must I explain the production of these currents in accordance with the statements of the text-books? An exposition of these induction currents with special regard to their occurrence in telephone circuits would be very acceptable to your "novice readers." Perhaps you can recommend some book which treats of this question? Yours respectfully,

FRÅGVIS.

Sweden, Kapparberg, *November 17th*, 1882.

[We will endeavour to reply fully to our correspondent's queries in our next issue.—EDS. ELEC. REV.]

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I see by your last issue that you desire to hear the opinions of students on the various courses of electrical engineering which they are attending.

As a student at the City and Guilds of London Institute I beg to say that, in my opinion, the *lectures* are all that could be desired. But as regards the experiments, I am afraid there is much to complain of. In the first place the rooms are too crowded; indeed so much so that I have frequently spent an hour in unsuccessful endeavours to perform an experiment. Secondly, the only assistance the student receives, as a rule, in carrying out the experiments is from the written instructions attached to the instruments, which are ofttimes too vague to be understood by the "beginner." As regards electrical tables and formulæ, as far as I can recollect, no attention has yet been paid to these subjects. No "home lessons" are given to the students to prepare. With reference to your last query, the lectures are very fully illustrated by experiments, but on account of the crowded attendance they are invisible to a large proportion of the students present.

In conclusion I might state that I should be all the more pleased if greater attention was paid to the construction of machines, lamps, &c., as a mere knowledge of the theory can be obtained from any text-book on electric lighting.

I remain, dear Sirs, your faithfully,
F. W. F.

London, *November 21st*, 1882.

ELECTRICAL TRICYCLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I have read with much interest your article on Messrs. Ayrton and Perry's new electric tricycle, but I have looked in vain to see that any provision has been made to comply with the Locomotives (Roads) Act.

The introduction of foot-treadles would not suffice, as from the description it would appear that the tricycle could travel on level roads without their use, and would therefore be an infringement of the Act as laid down in Parkyns *v.* Priest. I think for the protection of the public that this matter should be thoroughly thrashed out, as the *user* and not the inventor is made the victim of the £10 penalty.

Yours, &c.,
CHANCERY LANE.

TELEPHONE COMPANIES AND OVERHEAD WIRES.—We understand that for some time the local telephone company and the Birmingham Corporation have been in communication as to putting the wires underground, and that very shortly the work of placing telegraph wires below the streets will be begun. The company's representatives say they have always endeavoured to fix their overhead wires so as to enable them to resist any gale of wind which may attack them, but while well assured as to their safety they feel that the time has arrived when an effort should be made to avoid the necessity for extending their overhead system. The fire which recently occurred in Manchester, and damaged the overhead wires, is an argument in favour of the telephone company's desires.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

FRENCH PHYSICAL SOCIETY.—The first meeting of the French Physical Society, after its vacation in August, September, and October, took place on November 3rd, under the presidency of M. Gernez.

M. Jablochkoff presented two forms of his Ecliptic motor, of which we gave the description in an October number of the ELECTRICAL REVIEW.

M. Berson gave the results of his studies on the influence of temperature upon magnetisation in iron, steel, nickel, and cobalt. He places for this purpose the bar to be tested in a constant magnetic field at various temperatures and compares its magnetic moments by the Gauss method.

His apparatus consists of a Bunsen pile of from six to ten elements, from which the current, after having passed through a commutator, traverses a rheostat of retort carbon and then passes through the bobbin which serves to produce the magnetic field. A galvanometer, inserted in a derivation, allows of keeping this current constant. In the magnetising bobbin is placed the bar, which acts on a small declination needle suspended by a thread of cotton in the interior of a copper cage. The derivations are read by means of a mirror and scale.

The magnetising bobbin, which must bear high temperatures, consists of a coiled wire, the coils of which do not touch each other, upon a glass core embedded in plaster. The whole is placed in a copper stove and heated by a gas-lamp. The temperature, which is kept constant as long as possible, is measured by means of a thermometer which dips into the stove.

The following are some of the results obtained :—

In iron, magnetisation is almost independent of the temperature. However, total and temporary magnetisations increase up to 260°, then decrease, whilst permanent magnetisation diminishes very slightly.

In steel, total magnetisation increases at first, reaches a maximum at 260°, and then decreases; temporary magnetisation follows the same course; permanent magnetisation gives a maximum at about 240°. Variations of temperature during the experiment have an influence upon magnetisation, which increases under these conditions.

If one raises the temperature of a bar magnetised when cold, its magnetisation diminishes; it is the same if one cools a bar magnetised under heat. If it is tempered it preserves a greater magnetic moment than if it had been made at a low temperature.

In nickel, total magnetisation increases slowly up to 240°, and, after 280°, diminishes very rapidly, and disappears entirely at about 330°. Nickel magnetised at a low temperature, and heated to 330°, loses all magnetisation; if, on the contrary, it is magnetised at 280°, and then slowly cooled, its magnetic moment first increases, then diminishes towards the ordinary temperature, but finally remains greater than at the temperature of magnetisation.

Cobalt behaves like steel.

Apropos of this communication, M. Bouty signalises a work by M. Poloni, who has studied the magnetisation of steel at high temperatures and the distribution of magnetism in a heated bar.

ELECTRICAL SCIENCE ABROAD.—A correspondent, writing from Monte Video, says :—"I would call attention to the following paragraph in 'Schwendler's Testing Instructions,' Vol. I., page 181 : 'This difference will be greatest when the resistance of the fault is considerable, *and it is situated much nearer to the distant than to the testing station*, WHICH MAY BE RECOGNISED *by the fact of the distant station being able to* RECEIVE *signals much better than the testing station*.' Although from an *a priori* consideration one might be led to accept this statement as correct, it is nevertheless not borne out by calculation (not even by calculations based on the example he gives on page 184, where

The resistance of the instrument, say,		=	4,757 ohms.
„	whole line	„ =	4,626 „
„	x	„ =	3,998 „
„	y	„ =	625 „
„	fault (z)	„ =	1,002 „)

Nor does it agree with the following extract, from the pen of Prof. Ayrton : 'The station at the *worse insulated end* of the line requires LESS battery power than the station at the other end of the line, in order that the current arriving at both ends may be the same.' My reason for bringing the subject before your notice is that I have been surprised to find the former view prevalent in quarters where I least expected, and where a little calculation would convince of the fallacy.

"The Edison incandescent light has been established at the 'Confiteria del Gas,' in Buenos Ayres, with great success. The American Brush Company have just made an experimental demonstration of their system in the same city, which, judging from the reports I have received, has also proved satisfactory.

"The River Plate Telephone and Electric Light Company have commenced telephonic operations in this city, and, judging from the goodly number of wires leaving their central exchange, must be doing a very fair business, notwithstanding that their charge is somewhat high, viz., 8·00 dols. (eight dollars) per month."

THE MUTUAL UNION TELEGRAPH COMPANY.—From the New York press we cull the following information, which will doubtless prove interesting to those of our readers who in any way follow the course of events affecting the Atlantic cable business of this country. The New York *Evening Post* of the 30th ult. says :—

To guard against the possibility that the present harmonious relations between the Western Union Telegraph Company and the Mutual Union Telegraph Company might be disturbed by some new moves on the part of Mr. Jay-Gould, stockholders of the latter company are now placing in trust, for five years, the voting power of a majority of its stock. The trustees are Mr. George F. Baker, President of the First National Bank; Mr. George William Ballou, banker, of No. 14, Wall Street; and Mr. Asa P. Potter, of the Maverick National Bank of Boston. A well-known trust company will be made the custodian of the stock-voting power.

The New York *Herald* of the 31st ult. also remarks :—

The trust of Messrs. Ballou, Baker, and Potter, will close when the majority of the stock shall have been deposited. The duration of the ring, according to a contract signed, sealed, and delivered, is to be five years. Since Saturday it had completed the needed amount of stock by the purchase of 11,000 shares.

The intelligence of this important operation was received late in Wall Street and was the subject of much speculation, of the mental sort, however. The motive of the combination is said to be to insure the shareholders of the Mutual Union Telegraph against the danger of its falling into the hands of Jay-Gould or the Western Union Telegraph Company. It has been asserted over and over again that such was already the fact. Mr. Gould some time last spring transferred 3,000,000 dols. of the stock to the latter company, and this strengthened the general suspicion that it would eventually absorb the whole property of its rival, as it had that of the Atlantic and Pacific and the American Union. Either the present movement sets at rest this suspicion, or it is simply a plan similar to that of which the sale of the "nickel plate" railroad was the outcome for concentrating the Mutual Union stock in the hands of a few, so that it may more readily be disposed of to its competitor at an exorbitant profit. This theory did not find many supporters last evening among the few speculators who at five o'clock had not yet left the "street." Mr. John G. Moore, the president of the Mutual Union, declared to a *Herald* reporter that the object which had been sought was to maintain the entire independence of the company. It would be conducted as it had been, as a competitor and not as an ally of the Western Union. It had been thus far the most successful enterprise of its kind that had ever been undertaken in this country.

CABLE REPAIRED.—The cable between St. Vincent and St. Lucia is repaired, restoring telegraphic communication with the islands of St. Vincent and Barbadoes. The cable between St. Vincent and Grenada is not yet repaired, and the cable between St. Croix and Trinidad is interrupted. Communication with Grenada, Trinidad, and British Guiana, is in consequence suspended.

"The Development of Electricity and the Solution of the Problem of the Wires."—This is the title of a pamphlet by H. R. Meyer, in which he advocates the general adoption of his patent permanent-way for electric conductors. The invention is thus described :—

"It consists of slabs of earthenware, cement, glass, or other suitable material constructed with a series of parallel grooves ; these slabs are laid end to end and the *naked* wires laid in the grooves, asphalt is then poured freely over the slabs and grooves, and the whole effectively insulates the wires. The grooves can be made large or small, and will accommodate indiscriminately large electric light rods or ribbons, or the smallest telephone wires. In order to economise space, tier above tier is laid of these slabs, and to further secure the wires from all possible injury, the whole can be laid in a strong cast-iron channel."

There is no reason why Mr. Meyer should not bring his system forward by any means in his power, although its success is doubtful ; but he should avoid the scientific portion of the subject. He says, in speaking of copper ribbon :—

"There is one other point to be mentioned, viz. : That as electricity appears to travel on the surface of a conductor, the more surface is provided the less friction, or, as it is technically called, 'resistance,' and consequent loss of power takes place. Therefore a ribbon of copper, containing in section the same area of metal as a wire, will be a better conductor because of the larger surface it offers for the current to run on. But a ribbon presents technical difficulties in the insulating, and consequently with india-rubber or hemp, insulation is not practicable with that special section."

It is needless to comment on this paragraph as far as electricians are concerned, but it would have been well if Mr. Meyer had made himself acquainted with the relation of conductivity to sectional area of wires before presenting his pamphlet in a form which betrays the want of knowledge on the subject he advocates. If Mr. Meyer will take a tube of very thin copper, say, $\frac{1}{8}$th of an inch in diameter and of a considerable length, and a solid rod of copper of the same diameter and length, he would find on measuring their respective resistances that the copper tube was considerably higher in resistance than the rod, although it has both an outside and inside surface.

The Electric Light in Coal Mines.—Mr. Ellis Lever has offered to give a premium of £500 to any person who will invent the best portable electric lamp for use in coal mines. Mr. Burt, M.P., and Mr. Crawford, the Secretary of the Miners' National Union, have put themselves in communication with Mr. Lever for the purpose of rendering him their assistance in awarding the premium and in promoting the object he has in view.

Dangers from Exposed Electric Light Wires.—In our last issue we dealt with the many absurd stories that are floating about as to the dangers from electric light wires, and incidentally mentioned a communication addressed to the *Times* by A. I. C. E., the tone of which almost led us to imagine that theatrical managers had taken the writer into their confidence. The following letter has been sent to a contemporary :—

Sir,—Referring to your article in to-night's paper under the above heading, which is evidently pointed at me, let me inform you that your correspondent evidently knows nothing of my intentions as regards the use of the electric light in my forthcoming pantomime, and should not jump at conclusions and make assertions without previously having ascertained whether there is any truth in his remarks.

I am, Sir, yours obediently,

Augustus Harris.

Drury Lane Theatre, *November* 18*th*.

The Electric Light at Dundee. — Speaking of the attempt recently made to light New Commercial Street with the electric light supplied by 5 Brush lamps of 2,000 candle-power each, and placed one hundred yards apart, the local press says that the result of the experiment was somewhat disappointing. "The three lamps furthest from the engine were considerably dimmer than the two next it, and these were only moderately brilliant."

On a second trial one of the local papers states that "two of the lamps did not burn so brilliantly as the others, possibly owing to slightly defective connections, for in both cases the lamps beyond them were much brighter. The effect, though much superior to that produced by gas, is not such as was anticipated."

What a pity it is that these bad connections should be allowed to exist until found out by the representatives of the local press ! This fault seems to be a common one with those responsible for the installations of the Brush system. Is it not possible to engage men conversant with the advantages of good joints, or is the high electromotive force of the Brush dynamo-electric machines deemed sufficient to allow of the passing over of such a *slight* matter as a bad connection ?

Electric Lighting.—The Arbroath Town Council having considered the notifications sent them by several electric lighting companies, refuse concurrence, and remit to their Parliamentary Bill Committee to report on the whole matter, including the question of the Council asking for a Provisional Order.

The Kilmarnock Town Council, at a special meeting on the matter of electric lighting, agreed by a large majority not to take any action in the way of applying for powers.

In consideration of the small probability of any electric lighting company applying for powers to light Calverley, the Local Board, at last meeting, decided to take no steps towards applying for powers to supply electricity, and the proceedings of private companies are to be carefully watched.

The Swan Electric Lighting Company having addressed a circular to the Kirriemuir Town Council, the question of applying for a Provisional Order was discussed at their last meeting. As the price of gas is very high, a committee of the Council was appointed to wait on the gas company for the purpose of obtaining a reduction. If the request is not complied with, the electric light will be adopted.

The electric light is being fitted up at some of the principal mines in the Furness district. Lamps are placed over the pit heads, and by their light mining can be carried on by night as well as by day. At the Ronhead Mines of Messrs. Kennedy Brothers, the offices, workshops, and stores are illuminated by the electric light.

Leamington is to ask for a Provisional Order not only to supply electricity for lighting, but for "all available purposes." In their last contract with the gas company the Corporation reserved the right to illuminate three of the main thoroughfares by electricity.

The Councillors of Peebles, at their last meeting, had a letter read from their brethren of Elgin, to the effect that burghs should be allowed to select any company they preferred in the event of their going in for the electric light. After deliberation it was agreed that the communication should be on the table in the meantime, the Dean of Guild remarking that complaints regarding the high price of gas were numerous.

The Darlington Town Council, acting on the recommendation of their Gas Committee, are to apply to the Board of Trade for permission to supply electricity for public and private lighting.

In reply to an inquiry by the Morecambe Local Board, the Gülcher Electric Light Company intimate that they have no intention of applying for an order for lighting their district. The notice calling a special meeting of the board to consider the question of electric lighting has been rescinded.

The Folkestone Town Council are to apply for powers to introduce the electric light "if they deem it necessary."

A Provisional Order is to be applied for by Sheffield.

The Hammond Electric Lighting Company have been commissioned to illuminate the shipbuilding premises of Messrs. Andrew Leslie and Company by electricity.

The extensive works of Messrs. Wright, Turner & Sons, Pendleton, are being fitted throughout with Edison's incandescent lamps. The *Manchester Guardian*, commenting on the innovation, says :—"A number of the rooms are at present worked under the new light, and there is every opportunity for making comparisons between the new method and the old. Seeing them side by side, one cannot

choose but say that the gas is quite put out of countenance. On the question of cost the answer is satisfactory. The gas bill in a big mill is a considerable item. Messrs. Turner paid something like £400 to the Corporation last year, and the calculations they have made lead them to believe that their electricity bill will be about the same after making allowance for interest on the considerable outlay needed for the apparatus under the new system. They are putting electricity very much on the same footing as gas, placing a light at all points where there was formerly a gas-jet. The wires through the mill are covered with cotton coated with oxide of lead." The yard is lighted with two of Dr. Siemens' arc lamps. A number of millowners are waiting the results of the experiments with the intention of adopting the new light, should it prove successful. The whole of the business premises, including the shipbuilding yard and repairing docks, in connection with the extensive engineering and shipbuilding works carried on at Hebburn by the firm of Messrs. Andrew Leslie & Co., are being lighted by electricity. On Wednesday the start was made with thirty-four Brush lamps of 2,000 candle-power; on Thursday six more lamps were in use, and it is intended to fit up sixteen more, in all, fifty-six lamps. A number of other shipbuilding and engineering firms have adopted "the light of the future," amongst them Messrs. R. and W. Hawthorn & Co., St. Peter's; Messrs. Charles Mitchell & Co., Low Walker; The Palmer Iron and Shipbuilding Company (Limited), Jarrow; Messrs. Readhead & Co., Tynedock; and Messrs. Edwards, South Shields. The tenders of the Hammond Electric Lighting Company have been accepted by all the firms.

The Stirling Police Commissioners held a special meeting on Monday to consider the propriety of making an application for a Provisional Order. On the recommendation of a committee they decided that no application should be made for authority to supply electricity. The committee were desired to watch over and report any future procedure on the part of the two electric lighting companies who had signified their intention of asking for licences.

The Salford Town Council has decided that, in the present uncertain condition of electric lighting, it was not desirable to apply to the Board of Trade for a Provisional Order to enable the Corporation to supply electricity within the borough; and it was also resolved to oppose the applications of the different companies who had given notice of their intention to apply for such Provisional Orders.

Great Fire in Manchester.—A destructive fire took place on the 17th inst., in the warehouse of Messrs. G. Hodgkinson and Sons, makers-up and packers, Manchester, resulting in damage roughly estimated at £30,000, and the serious interruption of telephonic communication. The fire broke out in the top of a seven-storey building, and in a very short time flames issued from all the windows on each side. The fire occurred in the centre of the business part of the city, causing great alarm, and at one time grave fears were entertained for adjoining buildings. The building being near the central telephone office, the roof supported a standard on which nearly one hundred wires were fixed, and these were snapped asunder, the telephone system of the city being thereby disastrously affected. The loss of the Lancashire and Cheshire Telephone Company is estimated at about £200.

The Telegraph Wanted.—Petitions are being numerously signed for presentation to the Postmaster-General praying for an extension of the telegraph to Durness, Sutherlandshire.

The United Telephone Company (Limited) v. Orme and Company—The United Telephone Company (Limited) v. Butler—The United Telephone Company (Limited) v. Haines.—These were three actions brought on as short causes, before Mr. Justice Fry, on November 17th, to restrain the infringement of the patents of the plaintiff company for telephonic instruments. The first two actions were to restrain infringements in respect of receivers made according to Bell's patent. The defendant in the third action was also sued in respect of infringements in respect of transmitting instruments made according to Edison's patent. A defect in the patent has been remedied by disclaimer of the claim for the phonograph, and plaintiffs were now suing in respect of infringements subsequent to the disclaimer. Mr. Moulton appeared for the plaintiffs in all the actions; Mr. Williamson appeared for the defendants in the first action, and on their behalf submitted to a judgment, and expressed regret at having been guilty of infringement. In the other two actions judgment was taken by default, injunctions were granted, and inquiries as to damages directed.

Terrestrial Currents.—The week which is fast passing away and the one which preceded it will be memorable for the magnificent displays of aurora borealis witnessed and the extraordinary terrestrial currents felt at home and abroad. Judging from the reports of our private correspondents and from those which appeared in the daily press, there can be but one verdict, that the series of storms recently experienced have not been surpassed, if equalled, for many years. Our remarks may be more acceptable if we divide them into two sections, the first dealing with the auroral displays and the second with the earth currents.

Aurora Borealis.—The auroral displays have been so frequent of late that only those of importance have been chronicled. On Monday, the 13th inst., the dwellers in the Islands of Orkney viewed a grand display of the "Northern Lights." The whole sky from west to north-west was illuminated by a continuous arch. From the extremities of this arch streams of light stretched to the zenith, while streaks of light of variegated colours flitted about with rapidity, suddenly disappearing and reappearing, and occasionally forming comet-tail figures. On the evening of the 17th, shortly after darkness set in, their attention was attracted by a very unusual display in the south. The sky all round turned very red, next pink, and then yellow. The streamers instead of going towards the zenith ran along from east to west; their different colours producing very pretty effects. Shortly afterwards the sky to the south became hazy. The weather was extremely cold. The aurora was first observed in Scotland about 6 p.m., in the form of broad bands of red light stretching across the heavens from east to west. The appearance of the western sky was at one time such as to convey the impression that a serious fire was raging in the outskirts of the city. As the red light died away it was followed by strips of light blue and green, these in turn giving place to others of blue in the northern sky. While waves of white light ever and anon flashed from south-east to north-west. The display continued with varying brilliancy far into the following morning. In other parts of the United Kingdom, shortly after 5 o'clock, a beautiful rose pink aurora was seen in the western skies, which in a few minutes extended across the zenith and well into the east, covering fully one-third of the cloudless heavens. As the evening wore on the display continued with varying brilliancy whilst ever and anon columns of light shot up to the zenith from an arch of greenish light, centred with a mass of bluish-green, situated in the north. American telegrams announce the appearance of a magnificent aurora on the same day, which was visible at all points except where clouds obscured it. Cold weather with snow accompanied the storm in many places.

A correspondent writes to a contemporary on the 18th inst. as follows:—"Last night at about five minutes past six o'clock, while observing the aurora borealis in the northern part of the sky, I observed a most luminous mass, shaped somewhat like a torpedo, moving majestically from east to west over a large arc of the heavens, travelling about 160 degrees in about two minutes. The appearance of the mass was similar to the glow produced by the electric current passing through a vacuum. There was no neucleus, and the illumination was perfectly uniform."

The signalman at Tipton, St. John's Station, says he noticed a bright mass of light suddenly appear in the east, and pass swiftly to the west. It was visible from fifty to sixty seconds, and during that time the block and signalling instruments were greatly affected. During the passage of the object, and for some seconds after its disappearance in the west, the block bells were continuously rung.

In connection with the foregoing, M. Flammarion, the Parisian astronomer, received a telegram on Thursday from M. Bruguière, at Marseilles, informing him that there is at

the present moment a quadruple spot on the sun's surface, visible to the naked eye, and of far greater size than the earth. Magnificent aurora borealis is reported from Norway. Strange to say, this is the seventh time this year that the northern lights have made their appearance simultaneously with the presence of enormous spots on the sun's surface.

Mr. J. M. Rodwell, M.A., describing the cluster of spots at present visible on the lower eastern side of the sun's orb, somewhat below the equatorial line, says :—"Phenomena very nearly similar were seen on August 20th, since which time the sun spots have been in a state of constant and active change. Supposing the diameter of the sun to be 882,000 miles, each of these spots must be from 25,000 to 40,000 miles across."

The space at present at our disposal is so limited that we are reluctantly compelled to omit many interesting details, and hasten to "Earth Currents."

EARTH CURRENTS.—A *Times* telegram, dated Philadelphia, November 19th, says :—The electrical storm which began to derange the telegraph wires on Friday last still continues, though with less intensity. It spread through Canada and the greater part of the United States as far west as Utah. The electricians say that the disturbance was unlike anything heretofore known, acting upon the wires in strong waves, which produced constant changes in the polarity of the current.

The *Standard's* New York correspondent, telegraphing on Sunday night, says :—An electric storm, the wildest and severest ever known, has swept from New York West to Omaha and Kansas City, and northwards as far as the telegraph goes. The messages were almost entirely stopped. The successive negative and positive waves of the currents passed from east to west, alternately intensifying and neutralising the battery currents, and the instruments were repeatedly fused (?). At Nashville the galvanometer varied eighty degrees. Bangor worked a message a distance of 700 miles without a battery. At Milwaukie, by means of the storm alone, an electric light requiring eight horse-power was kept burning for some time. Reports from the Continent show that the storm was also experienced there, and that telegraphic communication was rendered almost impossible.

The *Daily News* publishes the following :—At Omaha the aurora borealis was so brilliant that night was made as light as day. At Cheyenne Denver, and at points in California and Washington, there were similar displays. At St. Paul's, Minnesota, the sky was of a blood-red colour, making an effect at once grand and fearful. The telegraphic communication was seriously interrupted and various experiments were tried to work the wires without success, until it was discovered that by taking two wires from the ground between two points and joining their ends a circuit was formed that could be worked. In this way eight wires were made to do the service of four.

While we admit that the storm was of unusual severity, we suspect the imaginative powers of the American correspondents have been largely drawn upon, particularly as to the electric lighting and the *discovery* of the value of a metallic circuit under such disturbing circumstances by the American electricians.

At home earth currents have been more or less prevalent for some time, and during the early part of Friday, the 17th inst., they took joint possession of the wires for a couple of hours, and gave some trouble. About midnight they again showed themselves, but not materially interfering with the workings of the circuits they received scant attention. At 10.25 a.m. on Friday earth currents suddenly appeared on all the lines, and such was their strength that they practically took possession of the entire telegraphic service of the country. On the railway systems the alarm bells were kept ringing, and the needle of the speaking instruments rested on the stop-pins after the dials had described arcs of about 45 degrees.

On the Postal system looping where possible was quickly resorted to with beneficial effect; but where no such arrangement could be made work was seriously impeded, and at times entirely stopped. This state of affairs lasted, with but little variation, for about two and a half hours, when the wires regained their normal condition. All went well until the hands of the clock pointed to 3 p.m., when the currents began to reappear, and continued to increase in intensity as time sped on till midnight, when their strength began to decrease; but they had not entirely disappeared at 4 a.m. next morning, when the principal circuits closed. The maximum force attained is said to have been about 60 volts, one observer says 80. Remarkable features of the perturbations were the rapidity with which the currents changed direction, their celerity in attaining their maximum strength, half a second (?) being the time required in many instances, and the effects produced on the east and west lines, which were greater than on those running north and south.

On Saturday at 10.30 a.m. the lines to the east and west and north and south were interrupted by terrestrial currents of strengths which necessitated the working of metallic circuits. Throughout the day they were more or less troublesome, and Sunday morning was advanced before they vanished *in toto*. Monday morning brought with it a renewal of the storm, and until 5 p.m. the currents were very troublesome. They reached a maximum intensity at noon, and as on the preceding days were variable in directions. In the evening with an auroral display they returned, and made working so difficult that the Post-office authorities had to issue notices of probable delay to all places. On Tuesday there was another renewal of the disturbances, the direction of the currents being from north to south.

SNOWSTORMS.—Last week a heavy snowstorm visited England. At Warwick telegraphic communication was suspended during the morning, and at Kidderminster the telegraph wires were broken by the weight of the snow clinging to them, and fell in one of the main thoroughfares, fortunately, however, without injuring any person.

SCIENCE LECTURES.—On Saturday evening, November 11th, a lecture was delivered to a very crowded audience (many being unable to obtain admission), at the Working Men's College, Great Ormond Street, by Mr. Wm. Lant Carpenter, B.A., B.Sc. (Lond.), on "The Telephone, Microphone, and Photophone." Sir Henry Lefroy, R.A., ex-governor of Tasmania, presided, and in introducing the lecturer, spoke of that gentleman's personal experience of the working of the telephone, &c., in America, Australia, and New Zealand.

Mr. Carpenter commenced with an exposition of the elementary principles of wave motion, and the propagation of sound by it through solid, liquid, and gaseous media. In this connection he reminded the audience of Wheatstone's telephonic concert in 1855 at the Royal Polytechnic, the closing of which he deeply regretted (applause). A drawing of this, illustrating the transmission of musical sounds from the basement to the topmost storey of the building, was projected (as were numerous other photographs) upon the screen. String and other toy telephones depended on the same principle. The telephone of the present day, however, was electrical, and depended on the close relations between electricity and magnetism. The statement that "the transfer of electricity always produces magnetism, and the motion of a magnet always produces electricity," was explained and actually demonstrated by experiments projected on the screen. It was then pointed out that the earliest electrical telephone, that of Reis (1852), transmitted musical tones only, and that its action was due to the fact that soft iron emitted a sound when temporarily magnetised. The first electrical transmission of articulate speech was achieved by Alexander Graham Bell in 1876. Mr. Carpenter gave a very interesting sketch of the steps by which his friend, Mr. Bell, was led to a solution of this problem, which grew out of an entirely different line of research, viz., the construction of instruments which should graphically record sounds in such a way as to assist in teaching deaf mutes to speak, and began with Kœnig's manometric capsule and a rotating mirror to analyse the flame-images. The action of Bell's telephone depended on the following principles :—

1. The passage of sound through the air in waves, causing an iron disc to vibrate mechanically.

2. The alteration in the condition of a magnet by any change in its "field" *e.g.*, by the vibration of the iron disc in front of one pole.

3. The excitation of undulatory electric currents in a coil of wire surrounding such a magnetic pole.

Details of the construction of the instrument were given.

as well as of the series of changes involved in its use, both as a transmitter and receiver. The microphone was then explained and its application to the construction of telephonic transmitters, and the lecturer thus led up to the subject of telephone exchanges, upon which he spoke at some length, contrasting their rapid development in America with their slow adoption in this country. The recent rapid extension of their use in New Zealand, as shown in official reports he had just received from there, was commented on, and Mr. Carpenter incidentally recounted a conversation held between Wellington and Napier, 232 miles apart, with ordinary Blake transmitters and Bell receivers, over railway lines near wires conveying battery currents. He also mentioned several other telephonic feats that had occurred within his own personal knowledge, and then passed on to the consideration of the photophone.

As the action of the microphone depends upon alterations in the electric resistance of pieces of carbon by air-waves of sound, so the action of the photophone depends upon the fact that the electric conductivity of (the rare element) selenium, is altered by rays of light falling upon it. Details were given of the construction of the instrument. The transmitter consists of a thin flat mirror reflecting a steady beam of parallel rays of strong light. Speech uttered near the mirror causes it to shake, producing vibrations in the reflected beam also. At the receiving station these beams are collected by a parabolic mirror, and concentrated upon a selenium cell, through which an electric current is passing, a telephone being also included in the circuit. Variations in the beams received from the distant station produce variations in the intensity of the current passing through the cell, and these are converted by the telephone into a series of sounds. Thus articulate speech can be transmitted by variations in a beam of light, without the intervention of any conducting wire, and by these means, using a beam of sunlight, speech had been reproduced at distances measured as yet only by hundreds of yards. In its present stage, therefore, this marvellous instrument was more scientifically interesting than practically useful.

NEW COMPANY REGISTERED.

INCANDESCENT ELECTRIC LIGHTING COMPANY (LIMITED).—Capital £250,000, in £5 shares. Objects: To manufacture and supply electric light and power, and to deal in cables, wires, instruments, and telegraphic and electrical material. Signatories (with 1 share each): R. E. Bell Crompton, Chelmsford; C. W. Torr, Birmingham; H. L. Thomson, Chelmsford; R. H. Milward, Birmingham; F. W. Simms, 47, Holborn Viaduct; F. T. Medcalf, 1, Great George Street, S.W.; Henry Lea, Birmingham. Registered 15th inst., without Articles of Association, by Milward and Co., 41, Waterloo Street, Birmingham.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

SWAN UNITED ELECTRIC LIGHT COMPANY (LIMITED).—The return of this company made up to the 3rd ult., was filed on 15th inst. The nominal capital is £1,000,000, in £5 shares. Upon £80,150 shares, £2 per share has been paid and 10,000 shares are fully paid up. The total calls paid amount to £160,300 and considered as paid to £50,000. Registered office, 9, St. Mildred Court, Poultry.

EDISON ELECTRIC LIGHT COMPANY (LIMITED).—The official return of this company, made up to July 20th, was filed on the 16th inst. The nominal capital is £1,000,000, in £10 shares. 20,000 A shares have been taken and £5 per share called thereon, the calls paid amounting to £100,000. Registered office, 74, Coleman Street.

BRUSH ELECTRIC LIGHT COMPANY OF IRELAND (LIMITED).—The return of this company, made up to the 28th ult., was filed the 20th inst. The nominal capital is £250,000, in £5 shares; but the seven shares taken by the subscribers to the memorandum and articles of association are all at present issued. Registered office, 31, Lombard Street.

ELECTRIC "SUN" LAMP AND POWER COMPANY (LIMITED).—The return of this company, made up to the 7th inst., was filed on the 10th inst. The nominal capital is £200,000, in £5 shares. 7,759 shares have been taken up and a call of £2 10s. per share has been made thereon. The calls paid amount to £20,206 and unpaid to £252. Registered office, St. Margaret's Offices, Victoria Street, Westminster.

NEW PATENTS—1882.

5346. "Incandescent electric lamps." J. JAMESON. Dated November 9.

5353. "Manufacture of carbons for electric lighting." H. C. B. SHALDERS. Dated November 9.

5359. "Means for insulating electric wires." W. J. TEMPLE and T. F. HOBBS. Dated November 10.

5373. "Improvements in electric lamps or lighting apparatus, and in the manufacture of light-emitting conductors for the same." J. M. BOULTON, J. PROBERT, and A. W. SOWARD. Dated November 10.

5387. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 11.

5388. "Manufacture of compounds of india-rubber, of gutta-percha, and of oils for insulating electrical conductors, and for other uses." A. PARKES. Dated November 11.

5391. "Improved apparatus for indicating or telegraphing the 'score' for athletic or other games, which apparatus is also applicable as an indicator for other analogous purposes." C. GREEN. Dated November 13.

5400 "Carbons for use in electric lamps and for other purposes." J. E. T. WOODS. Dated November 13.

5409. "Apparatus for electric lighting." J. MUIRHEAD and T. M. COLLET. (Communicated by G. A. Grindle.) Dated November 13.

5414. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 13.

5421. "Thermo-electric generators." H. WOODWARD. Dated November 14.

5422. "Manufacture of electrodes for secondary batteries." H. WOODWARD. Dated November 14.

5438. "Apparatus for the conduction and distribution of electric currents." R. E. B. CROMPTON. Dated November 15.

5492. "Electric light switches." C. MAYNARD. Dated November 18.

5495. "Electric arc lamps." BARON ELPHINSTONE, C. W. VINCENT, and J. COTTRELL. Dated November 18.

5504. "Manufacture of incandescent electric lamps." A. SWAN. Dated November 20.

5518. "Improvements in the distribution of electricity by means of underground conductors, and in conduits and apparatus therefor." C. D. ABEL. (Communicated by L. A. Brasseur.) Dated November 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1583. "Electric bell and battery." H. BINKO. (A communication from abroad by Moritz I. Siegel, of Austria.) Dated April 1. 6d. The inventor arranges the armature to work on pivots, and constructs the same specially by larger bells in two parts, one of which carries the knob and receives his action by means of a lever anchor or claw from the other part, so that a more correct striking is obtained, without vibration, and, notwithstanding the use of a shorter hammer, a much louder tone. The improved electric battery consists simply of a zinc rod or plate, and a cylinder or block formed of a mixture of carbon and manganese, to which is added a proportion of iron filings, oxide of iron or oxidulated copper by means of moulds and pressure, and excited by a solution, as usual, of muriate of soda or salamoniac.

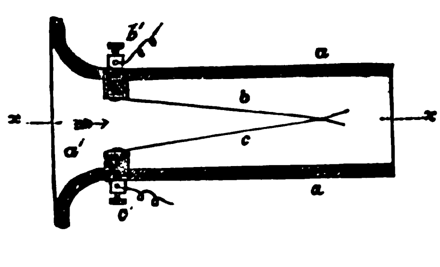
1619. "Carbon conductors for electric lamps." W. R. LAKE. (A communication from abroad by H. S. Maxim, of America.) Dated April 3. 6d. This invention relates to the manufacture of carbon conductors available for use in incandescent electric lamps. Such conductors, as is well known, have a slender thread-like stem, with enlarged clamping ends. As it is desirable that these strips should all be of exactly the same quality and size, it has been usual to cut them by a die from flat sheets of paper or wood in the form of flat strips with widened ends, but when plastic carbonisable compounds are used for making the carbon, it is very difficult to obtain any considerable number of strips of even approximately the same size and resistance by any of the old methods employed, such as moulding and then carbonising, or by cutting out the strips from a hard mass of carbon. This invention is designed to avoid these difficulties in the manufacture of carbon conducting strips of an equal width or diameter from plastic compositions, and consists in a continuous process of forming the said conducting strips, and in the devices employed therein.

1639. "Electro-depositing copper, brass, and bronze." W. H. WALENN. Dated April 4. 4d. Relates more particularly to the improvements set forth in the specifications, filed in pursuance of Letters Patent No. 1540, A.D. 1857, and in No. 3930, A.D. 1868. The first part of the present invention relates to electro-depositing copper upon iron or upon similar metals so that the coating may be soft and adherent. This part of the invention consists in using the solution at a boiling heat or near therto, namely from 150° fahrenheit to the boiling point of the solution. The second part of the invention is to prevent the evaporation of a solution which is heated during deposition. A cover with a long condensing worm tube is

used to the depositing bath. The upper end of the tube opens into a box containing materials to condense or appropriate the gases that escape. The liquids flow back down the tube into the tank. The third part of the invention consists in working electro-depositing solutions in a closed vessel under a known pressure, the pressure being applied by heating the solution, or otherwise. The closed vessel may be used for solutions in which there is free ammonia, or where other conditions arise in which it is necessary to enclose the solution, although neither appreciable increase of pressure arises, nor is heat applied. If there be much gas coming off, the condensing tube opening into a box, of the second part of my improvements, may be employed. The fourth part of the invention consists in adding to the charged and fully made copper, brassing, or bronzing solution, cupric ammonide in the cold until the solution is slightly green.

1663. "Arrangement of circuits, &c., to facilitate communication by telephone." F. D'Arcy Goold. Dated April 5. 6d. Has for its object improvements in the arrangement of circuits and in apparatus to facilitate communication by telephone. The inventor works with closed circuits, and at the "exchange" he provides a switch board to which all the subscribers' wires are brought; they are attached to a series of longitudinal bars of metal, each to each. The bars are insulated from each other, and also from other bars which cross them at right angles and which are for the purpose of coupling, as hereinafter described, any two subscribers who may desire to converse. Also near to, but insulated from, each bar of the series representing the subscribers' wires, there is a piece of metal, and a peg can be inserted between this and the bar. The insertion of the peg completes the circuit through the subscribers' wire and in this circuit a battery at the exchange is included. This is the position when the circuit is not in use. The circuit also includes, at the exchange, an electro-magnetic indicator which, by retaining its armature, shows that the subscriber to whom the indicator appertains does not at this time desire to converse. Whenever a momentary break in the continuity of the circuit occurs the armature falls away from the magnet; such a break takes place when the subscriber removes his telephone from its hook and so at once indication is given to the exchange of his desire to speak.

1684. "Telephonic instruments." A. E. Dolbear. Dated April 6. 6d. Relates to the arrangement of the parts of telephonic transmitters so that the sound or air-waves will so act as to diminish instead of increasing the compression or closeness of contact or approximation of the electrodes (or those portions of the instrument by whose action the vibrations of the air-waves are transmitted to the current) at that phase at which in other instruments there is the greatest compactness, compression or approximation and *vice versâ*. The principle of the said invention is shown in the figure,



which is a longitudinal section; *a* is a short tube containing two tongues or blades, or the electrodes, *b*, *c*, formed of thin metal of a width nearly equal to the diameter of the said tube and extending longitudinally from the wire terminals, b^1, c^1, toward the other end of the said tube. Each of these electrodes, *b*, *c*, is capable of slight movement towards and away from the other, and both are in connection with wires or conductors, b^1, c^1, from any source of electricity. When sound-waves or vibrations enter the tube, *a*, at the mouthpiece or aperture, a^1, they exert their action upon the inner surfaces of the tongues or electrodes, *b*, *c*, and it is obvious that the alternate augmentations and diminutions of density constituting the phases of these air-waves will tend to cause separations and approximations of the electrodes in the same order of succession, as above described.

1689. "Electric lamps." G. S. Young and R. J. Hatton. Dated April 6. 6d. The main object of this invention is to provide a simple and efficient means for automatically regulating the arc or distance between the electrodes in an arc lamp or semi-incandescent lamp. For this purpose the inventors provide the carbon or other electrode or electrodes requiring to be fed with a kind of brake or feed appliance, which is acted on by an electro-magnet or solenoid or equivalent means. This brake consists of one or more chambers or parts, containing each one or more balls or rollers (or it may be a ring in parts or a flexible ring), all so arranged that the balls are made to jamb the electrode (or it may be its holder or part connected therewith) and to move it into the proper position for forming the arc when the said chamber or part is acted on by the electro-magnet or its armature and to retain it in that position until the arc requires adjustment, whereupon the chamber is released by the electro-magnet, the balls being released from the electrode coming against a stop appliance on or connected to the lamp framing. The electrode being thus allowed to be fed the arc is readjusted, the electro-magnet again repeating the action before described.

1692. "Dynamo-electric or magneto-electric machines." T. D. Pyot. Dated April 6. 6d. Relates to machines known as dynamo-electric and magneto-electric machines. According to this invention · of bobbins the cores of which may either be of metal or other suitable substance, covered with copper wire and insulated in the ordinary way, are arranged cylindrically and in radial lines to an axis on which they are mounted and with which they are parallel, thus forming cylinders which constitute the armatures. The said armatures revolve between the interior and exterior of the poles of electro or permanent magnets of horseshoe form. These magnets are placed so that their poles may correspond with the radial lines of bobbins aforesaid. Thus as the armatures revolve each bobbin will be brought successively opposite the poles of the magnets until the whole number arranged on the radial lines are brought in a line with the ends of the poles of the magnets, and as one series of bobbins leaves the magnets the next follows in the same way, and so on.

1713. "Electric arc lamps." J. Brockie. Dated April 11. 6d. In all electric arc lamps hitherto constructed, which regulate by the action of a magnet or solenoid either in a main circuit or in a shunt across the arc or by a combination of both, the regulating armature or core bears a certain and definite mechanical relation to the releasing or feeding mechanism (usually a brake or clutching device) the armature being jointed directly or by levers to the disengaging brake or clutch. The inventor proposes to do away with this definite or direct connection, and to gear the regulating armature to the brake or other device by simple friction, or the friction of magnetism, so that the armature is free to take up various positions in relation to the brake or clutch and yet control it. The play of the brake or its lever is limited between two stops, this play being preferably very small, but the regulating armature or core may have a much longer travel or play; thus it will be seen as above stated, that the armature may take up various positions in relation to the brake lever, the particular position however being determined by the strength of the current; thus no alteration in the tension spring or balance weight acting against the armature is necessary, as the armature will accommodate its position automatically by the current employed. [See page 406 of present issue.]

1726. "Electrical apparatus for signalling on railways." E. Tyer. Dated April 12. 6d. In the specification to letters-patent granted to the inventor on the 1st July, 1881, a method of signalling on railways by means of electric lights is described, and also apparatus for operating according to that method. The present invention consists in improvements in the construction and arrangement of various parts of such apparatus, whereby the inventor is enabled to simplify them and render their action more certain.

1727. "Automatic current director for electric machines." W. Fisher. Dated April 12. 6d. Has for its object an improved device which the inventor calls "an automatic current director for electric machines," which is specially applicable to the machines used for the deposition of metals, such as plating and electrotyping. The device is for the purpose of preventing the current passing in the wrong direction which sometimes takes place as the machines are now used.

1747. "Dynamo-electric machines." D. A. Chertemps and L. Dandeu. Dated April 12. 6d. Consists in a self-exciting dynamo-electric machine, in which the authors have endeavoured to destroy the antagonistic effects of contrary currents which exist in all other machines, causing irregularities in the currents produced. (See Electrical Review, June 10th, 1882.)

1760. "Dynamo or electric current-producing machines." J. B. Rogers. Dated April 13. 6d. The object of this invention is improvements in the construction and arrangement of "dynamo" or electric current-producing machines. For the purposes of the invention the inventor mounts upon a spindle or shaft one or more series of helices or coils and revolves them as one body on one or on both sides of fixed magnetic rings or their equivalent. The rings may be full circles with indentations for an insulating medium to be fitted in, or they may be composed of half rings or segments with an insulating body between the meeting ends or edges for the necessary make-and-break action. The helices or coils may be arranged in single or in double circles to, in, or between supporting or connecting plates, or otherwise arranged to rotate around the face or faces of the fixed ring or rings. By the invention the inventor concentrates the current as generated into the centre of a large magnetic field from which the fluid can be taken direct by conducting wires to lamps for lighting purposes or otherwise ! ! ! ! ! He dispenses with the usual "commutators" or "Brush" on dynamo machines by the invention and obtains an increased quantity of electric fluid within a given area and of a more highly concentrated nature with less tendency to escape than by the present construction of dynamo machines in which the rings revolve and the coils or helices are fixtures ! ! ! ! !

1769. "Secondary batteries." J. H. Johnson. (A communication from abroad by C. A. Faure, of Paris.) Dated April 13. 6d. Refers to the details of construction of secondary batteries in general: A proper vessel to hold the liquid of secondary batteries is an object of great importance which it has been hitherto very difficult to obtain. All such materials as glass and pottery are too brittle and heavy, and not susceptible of being made very large; tanks made of wood must be very expensive, so as to be sound and resisting to change of temperature and moisture, however impregnated with hydrocarbonaceous substances, while metallic tanks are subject to corrosion, even when covered with any known varnish applied in the heretofore known ways. According to this invention, vessels, tanks and cisterns are constructed in such a manner that they are permanent, cheap and not easily breakable, iron copper or any convenient metal is employed to act as the main body or support of the tank and this is thickly coated on the inside and outside in the following manner. The surfaces of the tank are first coated with a varnish made of pitch linseed oil, paraffine and tar, applied hot, or any such like varnish: then sheets of asbestos, felt or canvas are prepared by soaking them with the varnish, and all the surfaces of the tank are covered with these sheets, put on in a hot state.

1774. "Electrical circuits, &c." A. Muirhead. (A communication from abroad by J. A. Briggs and Kinsman, both of Bombay.)

Dated April 14. 6d. The objects of this invention are :—To obviate the disturbing effects of induction, split currents, earth currents, &c., thus affording certain highly advantageous methods of utilising the same one-trough cable or line of supports for carrying two or more electrical circuits, irrespective of the nature of the said circuits. To increase the carrying capacity of the supports by affording a means of erecting aerial wires close together. (*Provisional only.*)

1803. "Manufacturing incandescent lamps." A. R. LEASK. Dated April 15. 6d. The inventor constructs a gauge as follows, though he does not bind himself to the precise materials and forms hereinafter set forth, which merely serve to illustrate the invention. Two tubes, one capable of sliding inside the other, may be used and a block inserted in the free end of each; each block is pierced with a small hole in the direction of the length of the tubes and binding screws are provided, one to each block and one to fix the sliding tube at the requisite position. There is a suitable stop in the inner tube between which and the block at its end is a helical spring. A slot is formed near the end of the inner tube to permit of the binding screw and block being pushed in, the spring having a tendency to force them out. An ordinary needle or equivalent is inserted in the hole in each block and block and needle secured by the binding screw.

DISCLAIMER.

2038. "Electric-lighting apparatus." HADDAN'S patent. Gulcher's Disclaimer and Memorandum of Alteration. Filed October 18th, 1882.

CITY NOTES, REPORTS, MEETINGS, &c.

BIRMINGHAM AND WARWICKSHIRE ELECTRIC LIGHT COMPANY (LIMITED).

LAST Wednesday afternoon, at the City Terminus Hotel, Cannon Street, under the presidency of Mr. G. M. Felton, an extraordinary general meeting of the shareholders of the above-named company was held, for the purpose of considering certain adverse proceedings which had been taken against the company.

The secretary, Mr. H. W. Atkins, having read the notice convening the meeting,

The Chairman said: Gentlemen, the reason of your being called together to-day is because of the action taken by certain shareholders with regard to this company, which your shareholders believe to be inimical to the interests of the company, and which, if persevered in, would ultimately probably be ruinous. You will remember at the last statutory meeting, held on September 15th, I placed before you a *résumé* of the company's business. We were then in negotiation with several large towns, and we had then, as I told you at the meeting, a contract which would be signed either that day or in a few days, for an instalment of 40 lights. That contract has been signed, and those 40 lights are either now running or will be in a day or two. We were also in negotiation with several large towns with regard to electric lighting, and also with various works to put up electric lights for manufacturing purposes. Unfortunately—or fortunately, whichever you please—the circular by Mr. Whiteley appeared, which said we professed to have what we never had, and about that time appeared a letter in the ELECTRICAL REVIEW stating that the Lane-Fox incandescent light had been sold to the British Electric Light Company and then subsequently sold to the Anglo-American Brush Corporation. This came before your directors as a surprise, and we were blamed that we did not take the proper precaution in looking through the agreement. But when our prospectus was issued a copy of it was lodged with our solicitors. They looked it through and submitted it to the Hammond Company; they looked it through and passed it. It was then submitted to the Anglo-American Brush Company. It was passed by them and returned to us. So that we *boná fide* purchased the exclusive right to the Lane-Fox incandescent light, which opinion we still hold and ask you to support us in. At that time Messrs. Ingledew and Ince were our solicitors, and feeling that the feeling of the shareholders would perhaps not go in an amicable direction if the solicitors to the vendee were also the solicitors to the vendor, we placed the matter in the hands of Messrs. Linklater. Upon the very day that Mr. Whiteley's circular appeared, and was sent round to the shareholders, we had a circular printed and the envelopes addressed, calling you together to ask your opinion as to the course we should take in reference to Sir Charles Bright's letter. We submitted our circular to Messrs. Linklater. We were then in negotiation for the re-purchase of the Lane-Fox light; so we did not send out our circular for a few days, as we hoped in a short time to bring these negotiations to an end and to be able to put before you something tangible, which would put the company in a better position than before. You will bear in mind that since this company was formed an Electric Light Act has been passed—Mr. Chamberlain's Act—which renders the value of an electric lamp much less than before, for now a company cannot insist upon a user taking a certain lamp necessarily. That was not our position when we purchased the Lane-Fox lamp. It is as well to bear that in mind. The legislature has had something to do with that change, whether wisely or unwisely I cannot say (a voice: "Wisely"). When we received Mr. Whiteley's circular we submitted it to Messrs. Linklater, and in that Mr. Whiteley said many things which were decidedly the reverse of complimentary to this company. Mr. Whiteley appears to have a policy of taking very few shares in companies, and sending out a large number of circulars. He holds twenty shares in this company; twenty in the Yorkshire company, and ten in the Jablockhoff. He sent to the Yorkshire shareholders, two or three days later, the twin brother to the circular this company received. Subsequently the Yorkshire people replied to that. He issued another circular to the Yorkshire company, and they replied to that; and then he issued one to the shareholders of this company. He says there were very numerous actions lodged against this company. The writ he speaks of was lodged by himself and a gentleman named Sprange.

Mr. Edmonds: There was no other action besides Mr. Whiteley's?

The Chairman: No; not at that time. Mr. Sprange had fifty shares only. Mr. Whiteley, in his circular, says, "I further learn that there are numerous actions pending against the various companies by shareholders who, like myself, have heard the statement in the prospectus, and believe it is false. It is stated further that in some instances shareholders who have brought actions have been paid back in full." Now, gentlemen, in answer to that I may say that not one single penny has been paid out (hear, hear), and not a single penny shall go out of the company so long as I am chairman. Immediately I heard of the action taken by Mr. Whiteley, although we had business in view, I said, "Put that on one side, we have now money at the bank and not one penny shall be laid out in plant until this matter is settled." With reference to the retirement of Mr. Evans and Captain Inman a good deal has been said. With reference to Captain Inman, I may say he only attended our meetings twice, and as he had to come up from Liverpool, he was thereby put to some inconvenience. He gave no reason for resigning. Mr. Evans did give a reason. We were negotiating then for the re-sale of the Lane-Fox. We differed about amounts, and Mr. Evans could not go with us. He consequently resigned, sending a cheque for the money he had had. And nothing could be more straightforward on the part of this gentleman. At that moment I felt that I should like to resign myself, but I also felt I should not be doing my duty to my friends if I did, many of whom took up shares because they thought I should do what was right. You have now every prospect of doing a fair business. Negotiations have been again opened to-day with the vendors, and we have an offer by which they return us very nearly one-third of our capital. Our capital is something like £75,000 or £76,000, and if we have to pay a dividend, surely we can pay a better dividend upon £50,000 than upon £75,000. I ask you to support the directors in these negotiations. I pledge you my word that we will come to no terms unless they are submitted to you, and if you agree with them we will go on with them, and not without. But to want to wind-up the company! I do not know the reason. Perhaps you can guess. (A voice: "Number one." Laughter.) I ask you to support the direction of the company, not only in the interests of yourselves, but in the interests of the shareholders who are absent. When these negotiations are completed you shall each receive a circular, and we shall then have a very fair prospect of good business in front of us.

Mr. Ratcliffe (a member of the board) proposed the first resolution :—"That it is the opinion of this meeting that the recent litigation which has been commenced is most prejudicial to the true interests of the company, and every opposition should be offered to the hostile proceedings against the company." He remarked that the company had been very much hindered by the steps taken by Mr. Whiteley, and of course it was utterly impossible for them to go on until this kind of thing was stopped. His impression was that the matter should be left to the board to arrange and manage. Of course he could not go so far as to say the expectations of those who took shares early would be so fully realised now as they thought they would be, still he believed this would be a fair going company. He had made a great deal of inquiry concerning the Brush dynamo, and he more than ever, perhaps, believed it was a very valuable concession.

Mr. Thomas Beard, C.C., remarked, in seconding the resolution, that he had been told so much about Mr. Whiteley that he thought he was a man whom they should shun. He should venture to designate him as a "wrecker" of companies. He was one of those who took shares in this company, being impressed with the names of the directors. He knew that Mr. Evans did not retire from the directorate in consequence of anything that would reflect upon himself. He was glad to hear the explanation of that event as given by the chairman. He hoped that the shareholders would support the directors. He personally felt confidence in the board, and believed his interests were safe in their hands.

Mr. Hammond said he had pleasure in supporting the resolution. Holding as he did a rather anomalous position as the largest shareholder in this company with his personal money, and with his close connection with the Hammond Company, being in some sense not in the same position as he was as a shareholder, he thought it incumbent on him, as representing the Hammond Company, to deny that his company had passed the prospectus of this company, or their position would not now be so strong as they considered it was to-day. He was sorry to introduce one note of discord into the meeting, but he really must deny that either he or his solicitors passed the prospectus of this company. He agreed with the directors in their policy. He stood up primarily to second the resolution. Still the meeting, he was sure, would think it was quite impossible for him to allow that public statement to pass unchallenged. They held that no liability whatever attached to the Hammond Company in this matter. It was true that the prospectus of this company was submitted through the Hammond Company to Messrs. Renshaw, the solicitors of the Brush Company, but the Hammond Company took up this position, that they sold to this company, word for word, without any addition, that which they received from the Brush Company. If there was any ambiguous language in the agreement, then it goes on to the company granting us the licence. He did not add to or detract from it. He was sure the business of this company should be left in the hands of those who were now directing its affairs, and not in the hands of an outsider who held a few shares.

In answer to a shareholder, the Chairman said, as a matter of explanation, he might say that the solicitor of the Hammond Company was solicitor to this company also.

Mr. David Evans said he rose, in the first place, to support the resolution, but also to state his reason for resigning, which was simply that he was not in accord with his co-directors. When he saw the letter of Sir Chas. Bright in the ELECTRICAL REVIEW, they had Mr. Ince's views upon the subject; and at a board meeting he moved that independent legal opinion be taken with respect to the whole situation. At their next board meeting he moved the following resolution, which he should like, in justice to himself and in justice to the shareholders, to read:—"That the only satisfactory arrangement which can be made with the Hammond company, in consequence of their inability to carry out their contract with this company, is for them to refund to this Company all the cash and shares which have been allotted to them, so as to enable the board to pay the shareholders of this company the full amount paid by them on their shares." Having submitted that to the board, and found it did not accord with the views of his co-directors, he then tendered his resignation. He felt that no compromise should be made. If a mistake had been made by the Hammond Company, he felt that a full claim should be made for the return. He deferred his resignation until the next meeting of the board, in order that the resolution might be shown to Mr. Hammond in the meantime. At the next meeting a letter was read from Mr. Hammond, suggesting a compromise, and saying that there should be a substantial return of shares and cash. But inasmuch as he was acting as the trustee of the shareholders, and representing their interests, he did not agree with his colleagues. They had all acted up to that time in a friendly and business-like manner; and he could speak highly of them. But the matter was one of importance, and he could not agree with them conscientiously. He stuck out for a full return, and he thought the view of the board at that time was in favour of a compromise. He therefore tendered his resignation, which was accepted. He did not think his policy was wild, or unbusiness-like, or inappropriate, inasmuch as after a week or nine days following his resignation he found his co-directors were pursuing the very same mode of attack upon the Hammond Company for the return of the money in which he the previous week had attacked them; and the policy he had advocated three weeks ago was the policy pursued that day.

Mr. Ince said he was sorry to differ from the chairman, who in his statement had said that Messrs. Ingledew and Ince had settled and approved the prospectus of this company. He (Mr. Ince) wished to say that his firm never had settled that prospectus in any shape or form. The prospectus was prepared by the promoters of this company, and his firm had nothing whatever to do with it. Looking at the general position of affairs, he said that on the 10th May the Hammond Company sold to this company a licence to sell and use the Brush dynamo and the Lane-Fox lamp, in the same form of words as the Hammond Company received them from the Brush. The right to use the Lane-Fox lamp was absolutely exclusive, so far as the Anglo-American Brush Corporation and the Hammond Company were concerned. The British Electric Light Company had a similar right to use the Lane-Fox, but not in the district of this company. It was a licence which they had never attempted to use, and was a licence of no value to them, inasmuch as they were not attempting to do any lighting in the district of this company. There had, therefore, been no loss to this company in consequence of the concurrent licence held by the British Electric Light Company. Mr. Ince said what the shareholders would have to decide was whether the statement in the prospectus was a material misstatement; and in the second place, gentlemen would have to swear in court that upon the representation of the exclusive use of the Lane-Fox they were induced to take shares. But, he would ask, how many of them were induced to take shares on that representation?

A Shareholder: Ah, that is your way of looking at it. We don't want to go into these questions to-day. We shall do ourselves much harm if we do.

The Chairman rose to order.

The Solicitor to the company deprecated any cross-questioning, as that would tend to injure the company.

Another Shareholder also questioned the wisdom of Mr. Ince's making any statement.

The Solicitor said: Having regard to the position of the company, and that there was a fair prospect of settlement of this dispute, he would ask Mr. Ince to make no further statement. It was not likely they would agree if they argued, and he could see no good in it. The result of cross-questioning would be to knock on the head certain negotiations which were going on.

The Chairman then put the resolution, which was carried unanimously.

A Shareholder: Is Mr. Whiteley here (laughter)?

Hon. Roger Molyneux then moved "That the chairman having reported to the meeting that negotiations were pending with the various parties interested, with a view to an amicable arrangement of the difficulties with reference to the Lane-Fox licence, be it further resolved that in the opinion of this meeting it is highly desirable that an amicable arrangement of the nature suggested should be come to, with a view to the carrying on of the business of the company, and that the terms of any arrangement should be submitted to the shareholders for their approval before the same is finally concluded." He might add that he was acquainted with those terms, and thought they could have nothing to complain of about them.

Dr. Mackenzie seconded the resolution, and remarked that Mr. Whiteley was legitimately engaged in his business of an auctioneer, selling off a company in the West End (laughter)?

There being no other business before the meeting, the proceedings then closed with a vote of thanks to the chairman, proposed by Mr. C·

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—We are informed that the rate for messages, *via* Galveston and the Central and South American and West Coast of America Telegraph Companies lines to Buenos Ayres, has this day been fixed at 16s. 4d. per word, and to all other parts in the Argentine Republic at 16s. 9d. per word.

DIRECT SPANISH TELEGRAPH COMPANY.—This company gives notice of the removal of its general offices to Leadenhall Buildings, Leadenhall Street, E.C.

THE Stock Exchange Committee have appointed settling days in the following securities:—Wednesday, November 29th: Devon and Cornwall Electric Light and Power Company (Limited), shares; Edison's Indian and Colonial Electric Company (Limited), shares; Gülcher Electric Light and Power Company (Limited), shares. The committee have refused a quotation in the shares of the Gülcher Electric Light and Power Company (Limited).

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations Nov. 22	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	10½-11	[illegible]
		Do. Do.	10	20 - 23	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1 - 1½	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½ - 1	
25,000	5	Great Western Electric Light & Power Co.	2½	½ - 1	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	4½ - 5½	
40,000	5	Indian & Oriental Electrical Storage Works Co. ..	2	1 - 1	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½ - ¾	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1½ - 1¾	
..	..	South African Brush Electric Light & Power Co..	2½	¾ - 1¼	
100,000	5	Swan United Electric Light Co., Limited	2	1½ - 2½	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	46½ - 47½	47½
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	77 - 78	77½
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	17 - 18	17½
130,000	10	Brazilian Submarine, Limited	10	11½ - 12	11¾ [illegible]
16,000	10	Cuba, Limited	10	9½ - 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	7 - 7½	
6,000	10	Do. 10 per cent. Preference............	10	16 - 17	16½
65,000	20	Direct United States Cable, Limited, 1877	20	11½ - 11¾	11½
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 - 103	
380,000	10	Eastern, Limited................................	10	10½ - 10¾	10[illegible]
70,000	10	Do. 6 per cent. Preference	10	12¾ - 13¼	13¼
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 - 103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 - 104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 - 106	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½ - 11¾	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891....	100	108 - 111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	104 - 107	105½
140,000	100	Do. do. registered, repayable 1900	100	103 - 106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 - 104	
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	102 - 105	
345,700*l.*	100	Do. do. do. To Bearer ..	100	102 - 105	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited..............	10	6½ - 6¾	6¾
163,209	10	Do. 6 per cent. Preference..............	10	12½ - 12¾	12½
125,000	10	Great Northern	10	12½ - 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 - 103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28 - 29	28½
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 - 103	
17,000	25	Indo-European, Limited............................	25	30½ - 31½	
38,148	10	London Platino-Brazilian, Limited	10	4 - 4½	4½
12,000	10	Mediterranean Extension, Limited	10	1½ - 2	
8,200	10	Do. 8 per cent. Preference................	10	7½ - 8½	
9,000	8	Reuter's, Limited	8	12½ - 13	
280,000	Stk.	Submarine..	100	245 - 255	
58,225	1	Do. Scrip	1	2½ - 2¾	
4,200	Cert.	Submarine Cables Trust	100	101 - 105	
37,350	12	Telegraph Construction and Maintenance	12	31½ - 32½	32½
150,000	100	Do. 6 per cent, Bonds, 1884 ..	100	101 - 104	
186,750	5	Do. 2nd Bonus Trust Cert. ..	5	1½ - 1¾	
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7½ - 7¾	7½
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 - 107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 - 100	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort.(Building) Bds.	$1,000	121 - 124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 - 103	
88,321	10	West India and Panama, Limited	10	1½ - 1¾	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5½ - 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000 ..	½	½ - ¾	
100,000	5	United Telephone Co.	5	10½ - 11½	[illegible]

TRAFFIC RECEIPTS.

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 31st October are £1,617, as compared with £2,098 in the corresponding period of 1881. The estimated receipts for 15th November are £1,540, as compared with £2,129 in the corresponding period in 1881. The July receipts, estimated at £4,931, realised £4 939.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts [illegible] the week ending 10th November, 1882, were £2,337, and for the w[illegible] 17th November, 1882, were £2,548, both after deducting the "[illegible] gross receipts payable to the London Platino-Brazilian Tel[illegible] of [illegible] (Limited).

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 262.

THE ELECTRIC LIGHT AND THE COMMISSIONERS OF SEWERS.

A FEW weeks since it was resolved at a meeting of the Commissioners of Sewers to take the necessary steps to supply the City of London with the electric light. This resolution was, however, reversed at the meeting held on Tuesday, the 21st ult.

Before commenting upon this rather extraordinary proceeding, we will proceed to give our readers an extract of the debate which took place, and which may be found very fully reported in the *City Press* of Wednesday, the 22nd ult., and the *Citizen* of the following Saturday.

Mr. Pannell brought up a report of the Streets Committee, submitting the opinion of Mr. Preece, F.R.S., as to laying conductors, &c.

Mr. Moore moved, "That Mr. Remembrancer be instructed to take all necessary steps to enable this Commission to become the undertakers for the supply of electricity under the provisions of the Electric Lighting Act, 1882, to obtain a provisional order under the regulations laid down by the Board of Trade, and to oppose the applications of all other parties." They had for years been smarting under the monopolies of gas and water. Special clauses were inserted in the act for the benefit of the local authorities, and they had now to decide whether they chose to allow six lighting companies to have the authority of lighting the streets of the City for the next 21 years, or whether they chose to take upon themselves the responsibility of applying for a provisional order or licence, and thus retain the authority for 21 years in their own hands. Unless the court came to a decision that day they would be effectually shut out, as the time for giving notice would have passed.

Mr. Boor seconded the motion. If it was difficult for the Corporation to discharge these duties how much more difficult would it be for half-a-dozen or a dozen companies to discharge them? The monopoly which existed among the electric lighting companies was far greater than among the gas companies, because it was in fewer hands. It was really worked in a ring of electricians. In nearly every instance the local authorities had passed resolutions to oppose the applications of the companies, and to try and get provisional orders to keep the power in their own hands.

Mr. Innes rose to move as an amendment, "That whilst the Commission is in favour of electric lighting *in the abstract*, it is advisable to allow all further experiments to be conducted at the risk of the lighting companies, and not at the expense of the ratepayers." *In the abstract*, they were not averse to improvement in regard to the lighting of the City, but at present they were not ready to take the steps suggested. They did not oppose improvements in lighting on their own merits, but they did oppose supporting a series of unknown experiments.

Mr. Baptie seconded the amendment. He was told the fear of a monopoly was a very important matter here, but he hoped the Commission would not legislate under the fear of monopolies one way or the other.

Mr. Noon said it appeared to him that Mr. Moore had proved his case up to the hilt, and that this Commission was in duty bound to get the right to light the City themselves.

Mr. Pitman had great pleasure in supporting the motion, as he felt it desirable that they should be the undertakers in this matter.

Mr. Stoneham said, although he supported Mr. Moore on the last occasion, that gentleman had gone a little too far in this question. He had hoped the Streets Committee would have brought them up a report as to the price of the lamps and upon various other points which they must enter into before they could become undertakers of the electric lighting of the City. If they began to lay down wires at the end of Fleet Street a man at Aldgate might apply for light, and they must give it him if they were the undertakers for the City. Although no one could be more anxious than himself to see the City well lighted, they must remember that they had a sacred trust, and ought carefully to sift the matter before coming to a decision.

Mr. Peebles thought the time had not yet come for the court to undertake with public money the responsibility of storing electric light in the City at the enormous expense which would be incurred. He had always been in the van in advocating the adoption of the electric light, but he did not contemplate that the Commission would take it into their own hands. From an estimate given by Dr. Siemens at the Society of Arts, he calculated that the cost of lighting a square mile of the City would be £708,000, or something like three millions for the whole area; and while they were engaged in putting up the works, such changes would probably take place as to make them think that three millions might as well have been thrown away.

Mr. Pannell said the Streets Committee had come to the conclusion that the electric light was undoubtedly to be the light of the future. Suppose they opposed the companies and got the necessary clauses inserted in their provisional orders for the protection of the City. The companies would then commence street lighting at the public expense with public money, and they might one after the other fail. There would be the survival of the fittest, but at any time it would be competent by Act of Parliament, when the Commission thought fit, to step forward to this fittest company, which had survived with the best and cheapest light, and say, "Now we will acquire it." Other companies might spend all their money in making this grand success, but they were not called upon to refund that or pay interest upon it. Suppose they followed Mr. Moore's suggestion, and applied for a provisional order, what position did they at once stand in with the companies? They would stand aloof, and say, "Pay us our price." He thought it was absurd to suppose they were going now to expend a sum of three quarters of a million or three millions, which in two or three years' time might have been absolutely thrown away.

Mr. Ashby remarked that according to the act they would become contractors, not merely for the supply of the electric light, but of electricity to be delivered in houses for whatever purpose it might be required.

Mr. Johnson thought the act was utterly impossible to be carried out, and next year he believed there would be a universal cry for an amended act. The conditions were a great deal too stringent. Under these circumstances, he must alter his vote on this occasion and oppose the motion.

Mr. Moore said there was so much that was in harmony between his views and the views of those who supported Mr. Pannell that without care they could not say where the line of distinction lay. In June, when he introduced the subject, he did not ask the Streets Committee to consider the matter hastily. He impressed upon them, in fact, everything which had been brought against his resolution today. But their hands were forced. Six electric lighting companies gave them notice that they were about to apply for provisional orders, and they could not wait. It was to-day or never. The question underlying everything was monopoly or no monopoly. He thought the amendment might with every fairness be added to his motion. That which he complained of was that it did not raise a fair issue. The matter had been under discussion four months, and he wished the court to make up its mind. He saw nothing in the act which it would be impossible to carry out, and he asked that those who had supported him would not allow dust to be thrown in their eyes. He asked any man of common sense whether the Government or Board of Trade would insist upon impossible conditions? He saw in the report strong arguments in favour of his resolution. Mr. Preece was asked to reply to certain questions, and was not asked for an opinion on the general subject. He said, "The whole question of the distribution of electricity for lighting purposes is in a very tentative state; sufficient experience has not yet been gained to determine exactly what is required under all circumstances, or even what those circumstances will be, and I think that those corporations who have taken upon themselves to supply electricity have undertaken a responsibility that they have not sufficiently contemplated, and which, with the present state of our knowledge, is extremely difficult to discharge." He had no doubt that a dozen eminent electricians could be found to express opinions diametrically at variance with these conclusions. Messrs. Peek, Frean and Co. informed him that by means of the electric light they effected a saving of about 20 per cent., which included the cost of a separate engine. The lords of the Committee of Council on Education said the cost of the Brush light, including the carbons, was 3s. 10d. per hour, as against 16s. per hour for gas. What was there, he asked, to prevent them introducing the light by degrees, district by district, and then they might ultimately select the best. While Sheffield, Rotherham, and other corporations, had provisional orders he hoped the City, as the largest corporation, would not be left out in the cold.

The amendment of Mr. Innes was put and declared carried.

A division was demanded, the result being: For the amendment, 33; against it, 29; majority, 4.

When put as a substantive motion, there were: For it, 22; against it, 21; majority, 1.

Mr. Alderman Staples moved, "That the Remembrancer be instructed to appear on the application of the companies, and secure clauses protecting the public and private rights of the City."

Mr. Innes seconded the motion, which was agreed to.

The minutes of the last ordinary court having been read,

Mr. Stoneham gave notice of the following motion: "That, considering the vast interests at stake, a select committee be appointed to inquire into the necessary steps to be taken to enable this Commission to become the undertakers for the supply of electricity to the whole or any district of the City of London, under the provisions of the Electric Lighting Act, 1882, and report forthwith to this Commission; and in the meantime Mr. Remembrancer be instructed to oppose all other applications."

We think that almost everybody will be agreed that the amendment (in name only) proposed by Mr. Innes might have been tacked on to the motion of Mr. Moore. In common with a contemporary, we ask what does the former gentleman mean by electric lighting *in the abstract?* We can only imagine that he belongs to that class of people who are in favour of using the electric light as long as it is paid for by somebody else.

The decision arrived at, however, does not even now appear likely to be the final one, for we observe that notice to rescind this resolution has already been given in at the Sewers' Office. Such being the case, it is evidently useless to discuss the matter, but it would be interesting to know what motive influenced the present result. Perhaps the whole affair was looked upon as a choice of evils; on the one side an expenditure of money which might or might not be exceedingly heavy, and on the other the danger of another monopoly. We have no wish to suggest that interests, personal or otherwise, which possibly crop up amongst those in debate may have led to the determination of the Commissioners of Sewers' majority, and it may therefore be that the report of Mr. W. H. Preece, F.R.S., weighed somewhat heavily in the scale of Mr. Moore's opponents. Apparently Mr. Preece has gratuitously given more advice than that asked for, and this has evidently influenced some of those who might otherwise have voted for the motion under debate. The past President of the Society of Telegraph Engineers and of Electricians has always been—unless we are much mistaken—an opponent of electric lighting, especially to the arc system, in a passive sort of way. Towards an incandescence method we hear he has reason to be more friendly disposed. It appears to us to be an ill-advised and egotistical proceeding on Mr. Preece's part to depart from the questions asked of him for the purpose of indirectly throwing cold water on the efforts of those who view the electric light with favour. At least this is the light in which we view the concluding remarks contained in the report, which will be found in our other columns. We shall look forward with increasing interest to the reconsideration of this matter, for although the official time for sending in applications to the Board of Trade has passed, the board is still willing to entertain future applications, and we shall, therefore, probably yet see the Commission become the undertaker for the supply of electricity in the City of London.

OBITUARY.—We learn with regret that Mr. Drury, Chief Mechanician to the General Post-office, expired early this week. He was well known in the Postal Telegraph Service, and his demise wil' ' 'oss to the department he had served for so m~ was much respected by those who knew him

THE "FERRANTI" ALTERNATING CURRENT MACHINE.

WE are at last enabled to present to our readers a description and illustrations of this much talked of invention. It is well known that Sir William Thomson's name was connected with that of Mr. Ferranti as a joint inventor of the machine, and we purpose, first of all, to give an extract from the former eminent electrician's patent, dated December 26th, 1881, and numbered 5668. After describing various forms of dynamo-electric machines, the inventor goes on to say:—

"Another form of dynamo is shown in part at figs. 1 and 2. This consists of a wooden disc, A, with projecting

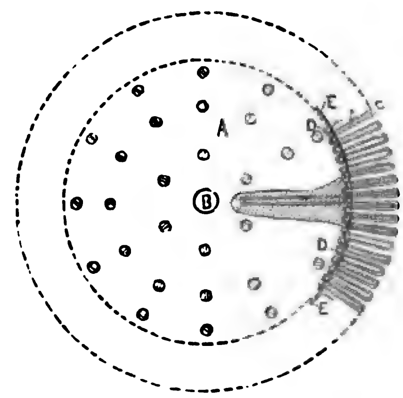


FIG. 1.

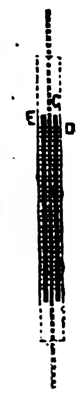


FIG. 2.

wooden teeth, *t*, the whole mounted on an axle, B. A flat slip of copper or a square copper wire, C, bent round the teeth, *t*, to the form shown in the drawing, is fastened to the edge of the disc, A, in the manner hereinafter described, and having its two ends passing in towards the centre of the disc to two suitably arranged contact-pieces. The fastening of the conductor, C, is effected as follows: a sufficient number of notches are cut across the edge of the disc, A, to receive the bends of the conductor, C. The conductor, C, being placed in position, wooden pins, D, are then laid in the notches over the conductor, the pins being of such a

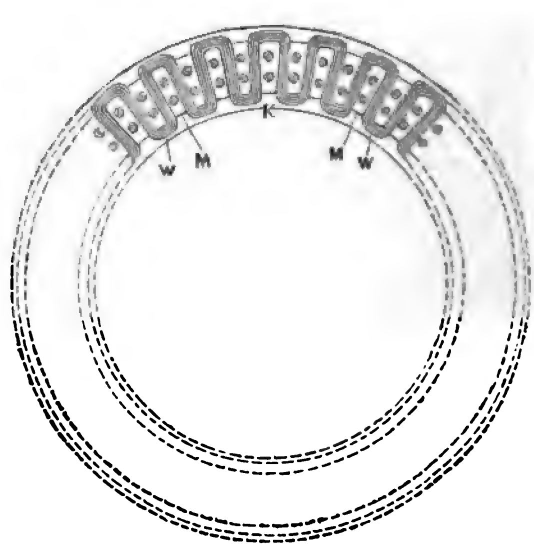


FIG. 3

FIG. 4

diameter as to project a little beyond the surface of each side of the disc, A. A stout steel wire, E, is then passed two or three times round the edge of the disc, A, on each side of the square wire, C, and so serves the purpose of pressing each wooden pin into its notch, in that way binding the conductor wire firmly to the edge of the disc, with strength enough to resist centrifugal force.

"When greater electromotive force and less resistance are required, the zig-zag may be made multiple of slip copper, as

hereinafter described, with reference to the group of electro-magnets for this form of dynamo at figs. 3 and 4.

"The hereinbefore-mentioned form of dynamo, as represented at figs. 1 and 2, is well adapted for an alternating current machine; the magnetic fields by which the radial portions of the moving conductor are excited being produced either by fixed steel magnets or by fixed electro-magnets, giving alternate areas of red and blue (true south and true north) magnetic polarity on the two sides of the space in which the radial bars move.

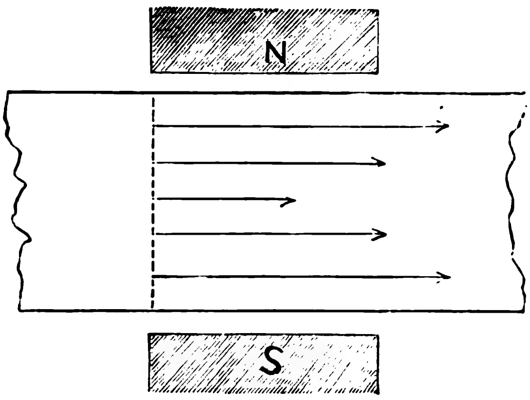


FIG. A.

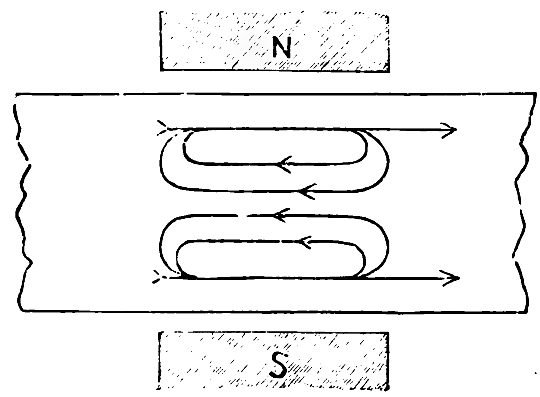


FIG. B.

"When electro-magnets are used, I arrange them as shown in part at figs. 3 and 4, so that each straight radial part of the conductor, W, serves to excite the soft iron of two contiguous electro-magnets, M, M.

"A flat circular cast-iron ring, K, is provided, having suitably shaped pieces of soft iron, M, M, bolted or screwed, as shown, on its surface. A flat strip of sheet copper, or a considerable number of mutually insulated flat strips are then bent, so as to pass round these soft iron blocks, M, M, in a zig-zag manner, as shown in figs. 3 and 4 (which is a transverse section of fig. 3), and with the breadths of the strips, W, everywhere perpendicular to the surface of the ring, K. A sufficient number of such copper strips, W, insulated from each other, and from the iron blocks, M, M, and ring, K, and joined in series, form the exciting conductor. In this form of dynamo, a separate exciter must be used, and any convenient form of brush may be adopted."

From this illustrated extract, our readers will be able to judge for themselves as to what extent Mr. Ferranti has been forestalled by Sir William Thomson, so far as priority of invention is concerned.

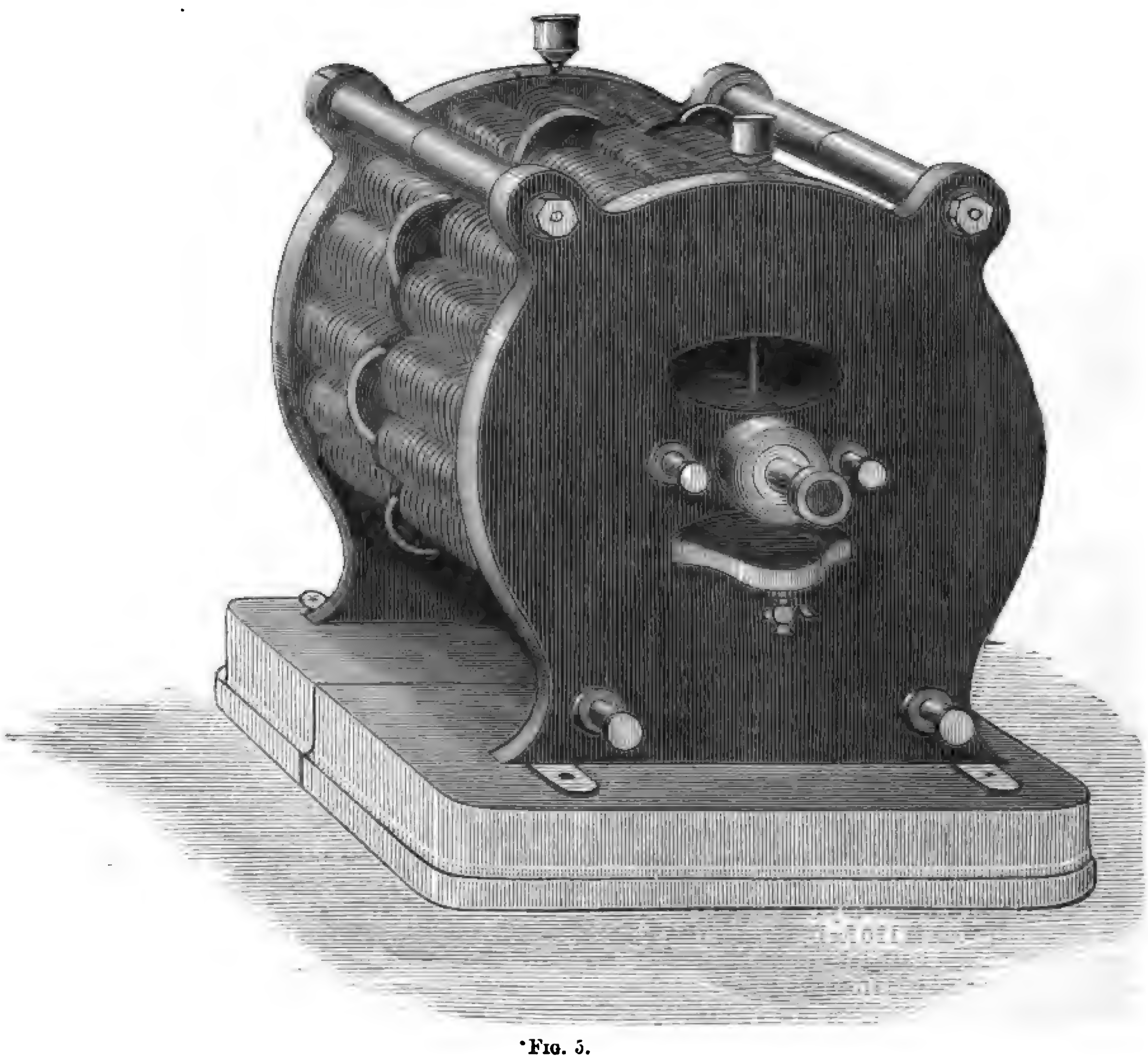


FIG. 5.

Some of our contemporaries, when describing the Gordon alternating current machine recently, spoke of the use of a ribbon of copper in these terms:—

"The use of a rod or ribbon for winding the coils instead of wire has recently been heard of a good deal. Mr. Gordon has experimented in this direction, and states that the effect of using a ribbon of such a width that the portion of its

diameter which is furthest from the magnet poles is in a field of sensibly less intensity than the portion near to them, was, that only a very small electromotive force was produced at the ends of the ribbon, an enormous quantity of horse-power was absorbed, and in two or three minutes clouds of smoke poured out of the machine, owing to the burning of the insulator. The reason of this is easily understood by looking at the figures, which represent a ribbon or rod of copper passing between magnet poles, the direction of motion being supposed perpendicular to the plane of the paper. In fig. A, the directions and lengths of the arrows represent respectively the directions and magnitudes of the electromotive force produced, while fig. B shows the direction of the current due to them. Thus we see that only a small portion of the current arrives at the ends of the ribbon, and that most of it is wasted in forming 'eddies' in the width of the copper."

We are not quite sure of the precise width of the ribbon used by Mr. Gordon, but we believe, that when speaking with him on the subject, he mentioned three and a half inches. However, whatever it might have been, we could not conclude that the heating effect as described above was due to local "eddies," but rather to some short-circuiting or other cause overlooked at the time. Why Mr. Gordon chooses to employ a ribbon of such a width as to place its middle in such a position that it passed through a magnetic field of sensibly less intensity than did its outside edges, is a matter which we do not pretend to understand. One cannot help thinking, however, that these remarks were aimed at the construction of the machine we shall now describe. Fig. 5 is a general view of the "Ferranti" dynamo-electric machine, and in a few words it may be described as being made up of a cast-iron frame in two pieces, each carrying 16 electro-magnets arranged in a circle, with their poles within a short distance of each other, and having between them a revolving zig-zag shaped ring of copper ribbon composed of 12 layers. The two ends of this continuous ribbon are connected, one to a ring attached direct to the axle supporting the armature, and the other to a second ring on the axle, but insulated from it. Two rubbers convey the alternating currents to two terminals, shown on the outside framework of the machine. The small pulley at the end of the axle is for the purpose of connecting the machine with a speed indicator. The electro-magnets are fed from a separate source, in this instance from a small Siemens machine of the D⁶ type.

The armature is partially shown in fig. 6 as it appears with

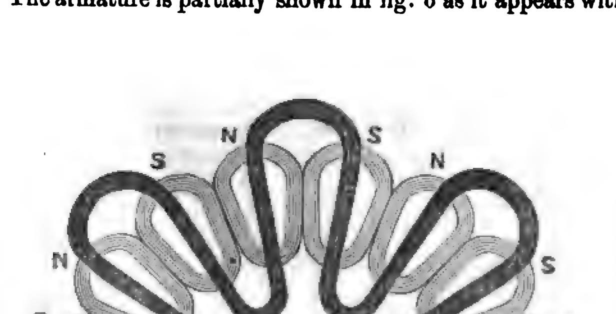


FIG. 6

one side of the machine taken away. The length of the copper ribbon, which is wound continuously in a zig-zag shape so as to produce 12 convolutions, is 120 feet. Its width is 12·5 mm., and thickness 2 mm., and its total weight 18 pounds. The convolutions are insulated one from the other by vulcanised fibre. The outside diameter of the armature is 21½ inches, and the mean diameter 15 inches. Its resistance is only ·0265 ohms. From these figures our readers may calculate the mean, or periphery, speed of the armature which, at the time of our first inspection of the machine, was running at 1900 revolutions per minute.

We are not able to give the mechanical details of the manner in which the armature is attached to the axle of the machine, as we understand publication of this portion of the apparatus would endanger some of the foreign patents. Our readers of a mechanical turn of mind could, however, doubtless suggest many methods of accomplishing such an object, and we therefore fail to see the necessity for keeping back such details from the scientific press, whose endeavour is usually to present a *complete* description of any apparatus its representatives are invited to *publicly* inspect.

The electro-magnets are alternately north and south, and their complete dimensions are as follows: length, about 6 inches; depth, about 4½ inches, and diameter at widest part, 3½ inches.

The core of each magnet is wedge-shaped with rounded ends.

The wire on each electro-magnet is 3·5 mm. in diameter, and consists of but four layers, weighing about 8½ lbs., and the total resistance of all the 32 electro-magnets connected up in series is 2½ ohms. The two lower terminals on the machine represent their ends.

The small Siemens' machine used for exciting these electro-magnets produces in them a current of 21½ ampères. Their poles are within ⅜ of an inch of each other, so that a very intense magnetic field is the result.

The height of the machine is 25 inches, and its base measures 24 × 22 inches. Mr. Ferranti informs us that its total weight is only 11¾ cwt.

This small and very compact apparatus, with the aid of the Siemens' "exciter" (weighing about 2 cwt.), was producing the current which kept 300 Swan incandescent lamps in action at a *stated* luminosity of 20 candle-power each. The lamps were arranged between the main conductors—which, by the way, were naked copper wires of one quarter inch in thickness—three in series, so that an electromotive force of about 150 to 160 volts should be required for each set of three lamps, and a current strength of about 1·4 ampères. We are informed that in the absence of any but approximate measurements, the machine may be considered as having an electromotive force, or difference of potential between its terminals, of 125 volts.

It will be quite understood that these figures refer solely to this particular form of machine, as any difference in its construction may be made to produce higher or lower electromotive force, and, therefore, more or less current. According to the table of tests on Swan lamps which we published at the time of our description of Gordon's machine, a lamp of this kind, when at a luminosity of 20 candle-power, showed a difference of potential of 52 volts, and the current strength was 1·4 ampères. The resistance of each lamp would then be about 40, and three of them in series 120 ohms. One hundred sets of three would give an external resistance of 1·2 ohms, irrespective of the conductors. Therefore, this would show that either the electromotive force of the "Ferranti" machine as given to us is too low, or that the Swan lamps shown in connection with it do not give a light of 20 candle-power each; or again it may be that the lamps employed are of a different type to those used by Mr. Gordon.

But these are matters of little importance now and can be put aside pending the results of trustworthy tests.

We are not aware that there is claimed for this machine much greater efficiency for horse-power expended than is obtained from certain other well-known types of dynamo-electric machines, but the following advantages are set forth:—

Its extreme simplicity, and therefore its non-liability to get out of order.

Its small size and light weight in comparison with other machines to do the same amount of work.

The trifling weight of the armature in comparison to the total weight of the machine.

The combination of a perfect mechanical and electrical construction and a high degree of electrical efficiency from the small weight of material employed.

The low price of the machine considering the work accomplished.

Whilst writing the above description of the machine we received every assistance at the hands of Mr. Ferranti. On Monday evening last a large number of gentlemen connected with the press and others scientifically interested in electric lighting met in the Cannon Street Station Arches, Cousen Lane, Dowgate Hill, for the purpose of publicly inspecting the "Ferranti" machine. The number of Swan lamps

in circuit had been increased to a total of 320, and we were officially informed that they are of that type usually employed by Messrs. Siemens Bros. for their installations of the incandescence lamps, viz., lamps requiring a difference of potential of 41 volts, and a current strength of 1·28 ampères to produce a light equal to 18 standard candles. The machine was then said to be producing 160 ampères, with an electromotive force of 125 volts. A considerable difference of opinion seemed to exist amongst those present as to the candle-power of the lamps, but as they were all strung so close together, it is quite impossible to give a fair estimate as to the amount of light produced, although we should be inclined to think that the luminosity was not nearly so high as that stated. We say this not merely from personal observation, but also from a comparison of the following figures given to us with those that have been deduced from many reliable tests. The indicated horse-power of the engine—one of John Fowler's 16 horse-power nominal—when driving both dynamo-electric machines in circuit with 300 lamps and including the interposition of countershafting, was said to be but 25·5, or, in other words, that 12 lamps of 20 candle-power are realised from each indicated horse-power. The engineer-in-charge of the "Ferranti" system informed us that the engine indicated *about* 7 horse-power when driving the countershafting and the machines free.

We leave our readers to make their own calculations and to decide for themselves whether the results said to be given by the "Ferranti" machine are correct.

Are the indications of the horse-power too low, or is the estimated candle-power of the lamps too high? As these are points which will be cleared up by reliable tests, we do not desire that our remarks should be looked upon as hostile to this latest development of dynamo-electric machines. On the contrary, we are extremely pleased with the new machine, and only wish to draw attention to those points in which errors may most readily occur. Mechanical engineers are apparently disagreed as to the advisability or even practicability of constructing such a form of machine with a very large armature owing to the difficulty which would probably be experienced in firmly securing the armature against the effects of centrifugal force, but we have sufficient confidence in the ability of our engineers to believe that no serious obstacle will arise in this respect.

The differences existing between the two latest dynamo-electric machines publicly exhibited is very striking.

The "Gordon" weighs, complete, 18 tons, its electro-magnets are excited by two "Bürgin" machines of considerable size, and it has been seen in operation with 1,300 Swan lamps in circuit of 20 (stated) candle-power each. It is constructed to actuate from 5,000 to 7,000 similar lamps with adequate driving-power. The wheel of revolving electro-magnets weighs 7 tons, and its diameter is 8 feet 9 inches. The weight of wire on the machine is 5,376 lbs.

Its speed at its maximum would be about 200 revolutions per minute, and it is coupled direct with the steam-engine.

The "Ferranti" weighs, complete, 11¾ cwt. Its electro-magnets are excited by a small Siemens machine, weighing about 2 cwt., and it has been publicly shown in connection with 320 lamps of a similar character to those above.

The revolving armature is 25 inches in diameter at its extremities, and its weight is 18 lbs.

The weight of wire on the machine is 290 lbs.

Its speed is about 1,900 to 2,000 revolutions per minute, and it is driven by belting from a pulley.

From these figures interesting comparisons may be made as to the relative advantages possessed by the two machines, although the "Ferranti" is placed at a disadvantage by reason of its very smallness.

In conclusion we wish the inventors and the Hammond Company, which is responsible for the introduction of the machine, every success with the future development of this most simple, compact, and efficient apparatus; and we shall be much surprised if the present dulness pervading the whole of the electric lighting business be not greatly brightened, and the prospects of lighting by incandescence in particular enormously advanced by the introduction of the "Ferranti" dynamo-electric machine.

A "Brush" 40-arc light machine, weighing two tons, was shown side by side with the little "Ferranti," and it was labelled to the effect that it was capable of producing 160 incandescence lamps. We trust, however, that no visitor was allowed to go away with the impression that it was constructed for such a purpose.

The advantages already enumerated are not, we think, exaggerated, and one of the great drawbacks hitherto existing, viz., the high prices of the machines, seems to be in a fair way of being reckoned amongst the things of the past. A point which must not be overlooked is the long time the armature can be kept running without any dangerous heating.

It is said that the machine we have here described might, with a trifling alteration, be made to give 500 lights, and a machine to give 2,000 lights, which is in course of construction, and which will be ready to be supplied at an early date, is only very slightly larger.

The large sizes which the company have in hand, are said to be capable of yielding 1,000, 5,000, 10,000, and 25,000 lights respectively.

The Hammond Electric Light and Power Company, Limited, who are the sole agents in England for the new machine, are already in communication with leading corporations throughout the country, in reference to an expenditure of capital under the provision of the Electric Lighting Act.

MR. PREECE'S REPORT TO THE COMMISSIONERS OF SEWERS.

GENTLEMEN,—Having heard from your engineer that you were desirous to receive my opinion on two important questions affecting electric lighting in the City of London, and after having had various interviews with Colonel Haywood on the matter, I have much pleasure in reporting as follows:—Question I.—Will it be practicable to lay in the same tube the conductors of different companies, for lighting by different systems of electricity, without the conductors so laid interfering injuriously with each other? Answer.—The answer to this question involves both a practical and an electrical point of view. Firstly.—From a practical point of view, there is no difficulty whatever in laying down a pipe containing separate conductors for different companies, and no trouble whatever would be experienced so long as the wires remained sound and good, and were undisturbed, but the moment failures occurred from defects in the insulation of the conductor, or from accident, or when additions were needed through the development of a system, difficulties of a serious nature would arise. Then the practicability becomes simply a question of dimensions. (a) If the tube be an iron pipe of 3 in. or 4 in. diameter, such as those used for telegraphic purposes, then it would be impracticable to maintain several independent electric light wires in it, for, as the insulated conductors have to be drawn in and out of the pipes, whenever additions or repairs have to be made, no company would consent to have its perfect conductors disturbed to allow another company to repair its defective ones. Nor under any circumstances could a conductor so placed be moved without there being a considerable liability to damage. All the conductors are insulated, either with gutta-percha, india-rubber, or other substances that are remarkably sensitive to damage when moved. At the present time damage is only prevented by the exercise of great care on the part of those who have acquired great experience, and it is hopeless to expect the exercise of such care on the part of rival companies towards the conductors of their opponents. We all know the tendency that there is on the part of subordinates and workmen to convert their feelings of rivalry into acts of maliciousness; indeed, already one of the great troubles that electric light companies have to meet with is the malicious interference of their conductors by workmen engaged in other concerns. Efforts have been made to introduce conduits, which shall prevent the necessity of drawing-in involved in the use of pipes, by constructing them so that lids or coverings may be lifted off to enable the con-

ductors to be placed in their position or removed. It has even been suggested that the kerbstones should be replaced by iron boxes, in which the wires should be laid; but all these plans have been condemned through the difficulties caused by crossing streets and side openings, by traffic, and by the necessity of protecting insulated wires from the varying changes of weather in this inclement climate. I know of no other practical plan than that of drawing in the conductors into pipes of sufficient size well laid beneath the streets. (b) If we take an iron tube of large dimensions, such as that which was some years ago laid down between St. Martin's-le-Grand and Euston for a projected pneumatic post, and which was about three feet in diameter,* the same objections still apply, though slightly modified; the conductors would, however, be equally liable to injury, either through accident or through wilfulness, whenever occasion arose for their being moved or examined. (c) If, however, we construct a subway large enough for men to circulate through, these objections would cease, for then each company would have its own conductors protected in an iron, lead, slate, or wooden casing, which would easily admit of examination and repair without the necessity for drawing in and drawing out, except for its own operations. Such a system exists in the sewers of Paris, where all electric light companies, telephone companies, and telegraphic systems can be accommodated without interference with each other, and without liability to injury. Such a system exists under the Holborn Viaduct and its approaches, and indeed for electrical purposes the arrangements carried out under the Holborn Viaduct and approaches are far superior to those which exist in Paris, the subways having been specially designed for the reception of pipes. Were the Holborn Viaduct system more extensively adopted throughout the City of London, all difficulties would cease. My opinion, therefore, is that, except in a subway of considerable size, it is impracticable to maintain the conductors of different companies in the same tube. Secondly.—From an electrical point of view I do not anticipate any injurious action from the electrical influence of one electric light conductor upon another conductor employed for the same purpose. If the flow of electricity be steady and uniform, and if the conductor, with its insulated coating, remain perfect, there can be no disturbance. When the flow of electricity is intermittent and alternate in direction, there may be serious disturbance upon telegraphic and telephonic wires, but I should not anticipate injurious disturbance to the electric light currents so long as the conductors remained well insulated. The disturbance caused by these alternate currents is very serious, and it is evident by the simple fact that if a conductor conveying such currents be enclosed in an iron tube, this tube becomes warm through its rapid magnetisation and demagnetisation due to the rapid changes in the electrical influence about the conductor; but this disturbance would not affect the flow of electricity for electric lighting. Hence, though there will be electrical disturbance, I do not think that it need be taken into consideration as affecting conductors employed for electric light purposes. Question II.—If the conductors laid in a district by any one company be discontinued, would they be available for any other company using a different system of electric lighting? Answer.—My reply to this question is, that that depends upon the system. If the conductor were laid for the Brush arc system it would not be available for the Edison incandescent system, whereas, if it were laid for the Edison incandescent system it would be available for the Brush system, though it would be very ill-suited. There are several systems of electric lighting in use, which may broadly be divided into (1) the arc system and (2) the incandescent system; and each system can again be divided into (1a) that which is worked with high tension and (2a) that which is worked with low tension electricity. We may take as a type of an arc system worked with high tension the well-known Brush, while that worked at low tension is represented by the Siemens. Again, the high tension incandescent is illustrated by that preferred by Mr. Swan, while that known as the Edison system is a low tension incandescent system. Now each of these systems, to properly fulfil its purpose and to be worked judiciously and economically, requires a separate and distinct system of conductors, whose weight, insulation, and form, vary according to each particular installation. The arrangement of conductors, to fulfil the requirements of an electric light system, is a very complicated matter indeed. It involves mathematical analysis, abstruse calculation, and great experience and skill to balance the energy expended at the central station with the work done in the streets and houses. I know of no branch of engineering where more forethought is necessary to calculate all the contingencies likely to be met with than a system designed to illuminate a large city like that of London. A conductor conveying electricity is not like a pipe conveying gas or water. The pipe which conveys fluids discharges, without material loss, the fluid put into it; but the conductor conveying electricity only does so at a serious loss of energy. The very fact of conveying electricity means waste. The conductor becomes warmed in consequence, and if the conductor be improperly apportioned to its work it not only involves a considerable waste of power, but it becomes dangerously and injuriously heated. Every system requires its own distribution dependent upon the area to be illuminated, the number of lights, the route of the conductors, and the position of the generating station. The whole question of the distribution of electricity for lighting purposes is in a very tentative state; sufficient experience has not yet been gained to determine exactly what is required under all circumstances, or even what those circumstances will be, and I think that those corporations who have taken upon themselves to supply electricity, have undertaken a responsibility that they have not sufficiently contemplated, and which, with the present state of our knowledge, is extremely difficult to discharge. Hence I say that while there may be cases where the conductors of one company may be available for another company, there cannot be a case where they are properly available unless the two companies employ the same system and utilise the same central station for the generation of their electricity, and for the distribution of their force.

(Signed) W. H. PREECE,

Past President, Society of Telegraph Engineers and of Electricians.

London, *November 2nd*, 1882.

* [This tube was 4 ft. 6 in. by 4 ft.—EDS. ELEC. REV.]

THE ELPHINSTONE-VINCENT DYNAMO-ELECTRIC MACHINE.

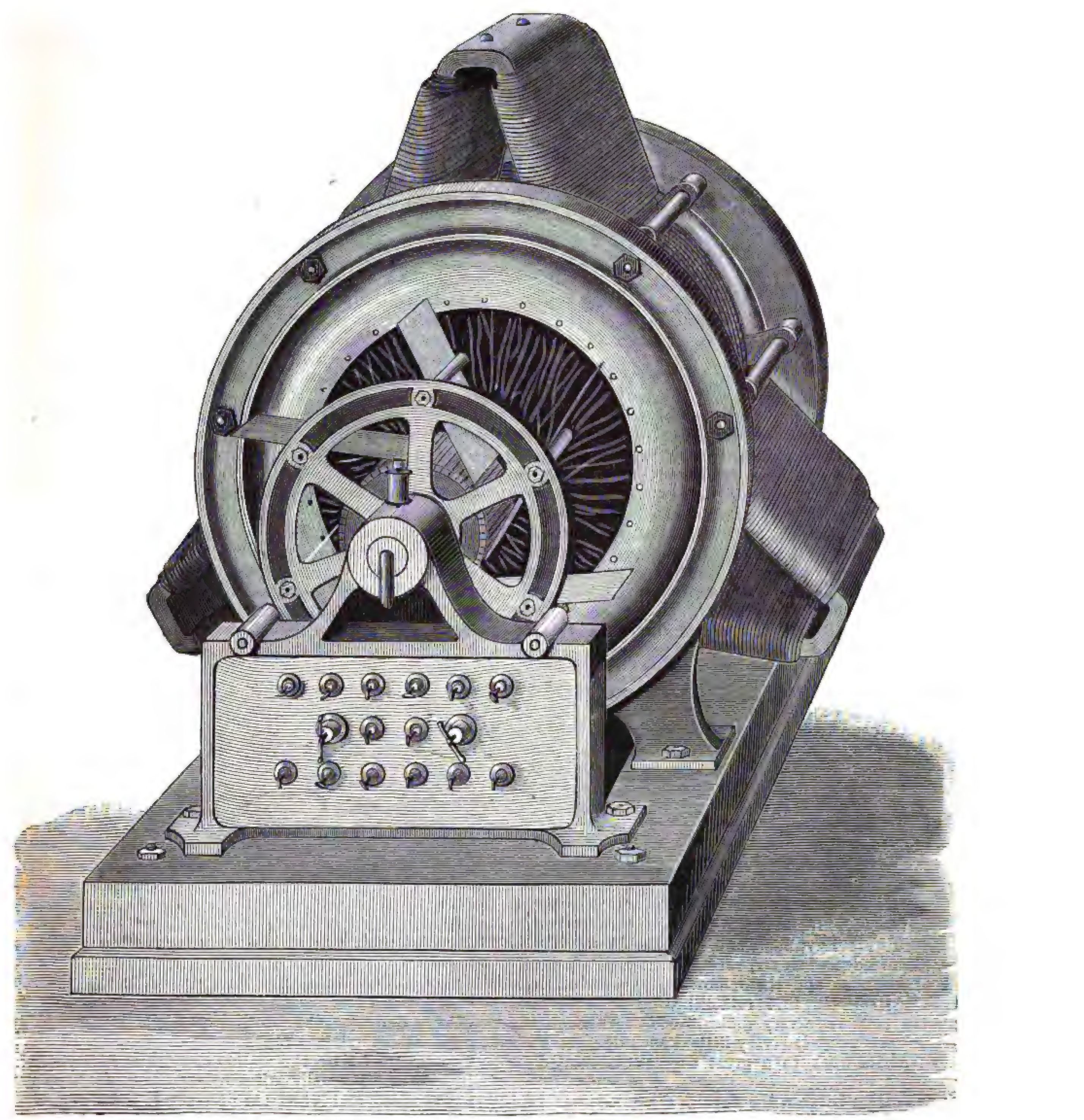
THE accompanying drawing shows a general view of this machine, which has been the subject of several patents. As long since as January, 1879, the above-named gentlemen took out a patent for a machine, which was subsequently improved upon. These improvements formed the subject of another patent, dated July 13th, 1880, and the improved machine was illustrated and described in our "Abstracts of published Specifications" columns, for April 1st, 1881. Various portions of the machine have still further been altered, and we shall refer to the details in a future issue. Several of these dynamo-electric machines have just been constructed, and we understand that their efficiency is very high, but in the absence of any data we can only make this statement with reserve. The machine here illustrated weighs complete about 26 or 27 cwt., and is constructed for working 400 incandescence lamps. It will be seen that three V-shaped electro-magnets surround the armature, there being therefore six poles of N and S alternately. Inside the armature is an iron spindle carrying six internal electro-magnets of similar polarity to those above.

The armature is not coiled with wire as is usually the case, but flat hollow parallelograms of double wire are constructed and laid on the outside surface of the armature drum, which is formed of a kind of *papier-mâché*. These parallelograms of wire are laid all round the drum overlapping each other, and they are firmly bound down with string or any suitable binding.

The ends of the wire coils are connected up with a commutator in all respects similar to that employed in the

Gramme machines. There are six brushes employed, which can all be easily adjusted to the best point of the commutator. The ends of the electro-magnets are brought to the terminals seen on the face of the machine—the inside ones through the spindle—so that any desired coupling may be made. There are several points of novelty in this machine which, however, we shall fully deal with shortly.

The arrangement of the armature drum, its coils, and the electro-magnets forms the chief feature in the machine, for it is by means of this that the external and internal poles of the



electro-magnets are brought very near together, thus forming a magnetic field of great intensity, through which the wire on the surface of the armature drum pass.

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Alexander Graham Bell, of telephone fame, ...apers of naturalisation, as a citizen of the ...at Washington on November 10th.—*The*

PROCEEDINGS OF SOCIETIES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this society was held on November 23rd, Lieut.-Col. WEBBER, R.E., president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of proposed new members read, it was announced that amongst the recent donations to the society was a medallion cast of Œrsted, which had been presented by Mr. ERICHSEN. Mr. LADD had also given to the society the original letter of Reis, dated July, 1863, in which his first telephone was described.

The president, having vacated the chair (which was then taken by Mr. W. H. PREECE), read a paper entitled, "Notes on the Telegraphs used during the Operations of the Expeditionary Force in Egypt." The work of one of the oldest members of the society, Col. F. Bolton, had not

been placed on record. This gentleman, as early as 1855 and 1857, had turned his attention to telegraphy as applied to military purposes, and in 1861 he had submitted to the Government a complete system. This system had been approved by Col. Shaw, and in 1862 Col. Bolton continued to interest himself in the subject, and read a paper on it at Chatham. In the same year he introduced a portable army telegraph; this was both acoustic and recording, which was a great advantage, since it could be read in the dark. In consequence of the very favourable report which was made on the system, it was fully adopted at the end of 1863. In that year Col. Bolton joined Capt. Coulomb and drew up a number code. Ten years ago Col. Malcolm and Major Webber read a paper before the society on "Military Telegraphy," in which a description was given of what had been done in the subject up to that date. The military telegraph system was then stated as being divisible under four heads, viz., "Permanent," "Semi-permanent," "Field," and "Visual Signalling." At that time Lieut.-Col. Webber suggested that numerical code signalling should be abandoned, and in 1876 this view was generally adopted, but unfortunately, although the same alphabet came into use, the language was not made to coincide, and this divergence was the source of some trouble in Egypt. In 1879 the author read a paper before the United Service Institution on "Orders in the Field and the Means of Communicating Them," in which he pointed out some of the requirements of a military telegraph system. The theoretical idea of a field telegraph in the front and a permanent telegraph in the rear was by no means easy to carry out practically.

The Egyptian State telegraphs are constructed on the Indian model. The mileage of line and number of instruments in use he could not communicate to the society, as no reliable statistics on the subject existed. The instruments in use were Morse printers of the pattern exhibited before the society by Col. Mallock in 1872. These printers were mounted on a board and were very complete, the plug switch at the back, however, which was used to change the station from "terminal" to "intermediate" sometimes led to faults. The wire used was of the usual galvanised iron description, the gauges being No. 8 and No. 11. The poles were similar to those used in Austria, being perfectly straight and rather above the average size of those employed in this country. The insulators were of the Andrews pattern, and were attached to the alternate sides of the poles, as in France; this was before the introduction of arms. The batteries were Minotto's, and on a No. 8 wire 100 miles long 12 to 18 cells would be used, according to the state of the weather. As compared with the Leclanché battery, he would remind the society that Mr. G. E. Preece, in a paper read in 1873, pointed out that the relative values were as 100 to 160. As regards maps of the circuits he would state that it was very rarely that circuit maps were ever complete. The *personnel* was composed of Egyptians and Europeans, the head of the department being Mr. Le Mesurier, who also controlled the railways; the immediate head was Mr. Floyer. The superintendents and senior clerks were European. Of the ordinary clerks 70 per cent. were Egyptians, who could only telegraph in their own language. The linemen were Egyptians, and practically possessed no technical knowledge whatever, except as regards the maintenance of batteries and the removal of line faults. The telegraph system was first established in 1858 by Said Pacha: the task was a very difficult one. Although the native workmen possessed very little knowledge, yet their capacity for hard work to a great degree compensated for this.

Communication between the Turkish dominions was kept up by a four-wire line passing through El Kantara. It had been stated in the daily press that one object of Professor Palmer's expedition was to destroy this line east of El Kantara; but Lieut.-Colonel WEBBER did not believe that this was the case, as no possible object would be gained by such action. The proper course to have pursued would have been to have placed instruments in circuit with the wires at El Kantara, so as to tap the circuits. The line of the Eastern Telegraph Company is carried along the east side of the railway through Kalyub, Cairo, and Ismailia. Although during the day the lines are all easily workable, yet at night, owing to the heavy dew, considerable loss of insulation occurs. The Eastern Telegraph Company have three stations in Egypt, namely, at Suez, Cairo, and Alexandria. The wires are maintained by the Egyptian administration. The way-leave for the wires being a free one over the State railway; this line was very much injured during the war. The Eastern Company had no line along the canal. When the cable was laid from Alexandria to Port Said, the object was to enable the traffic to pass over the canal wires and thus avoid delay. On the arrival of the Indian contingent at Suez, the employés of the Eastern Company established telephonic communication in the harbour, &c., and generally rendered great assistance. During General Wilkinson's march the employés rendered great assistance in repairing the damaged lines; 6 miles of the latter belonging to the Eastern Company were completely destroyed by Arabs, but this gap was bridged over by means of an Egyptian line which was destroyed in other places only. Owing to a mistake made at the junction pole the circuits were not got through. At Serapum, Fayid, and Geneffeh armed posts were established. Repairs were made by the Telegraph Corps during the night, so that in two days the lines were put right in spite of great difficulties. The telegraph line of the Suez Canal Company consisted of one through wire and one wire with stations at every "gare," or places where the ships crossed each other. The line of the Canal Company was not appropriated, but after a time they consented to signal and receive messages, although opposition was offered at first. The whole line of the canal was guarded by blue jackets, who paraded twice a day along their respective beats in spite of the severity of the heat.

Lieutenant-Colonel WEBBER here spoke in the very highest terms of the important services which the Naval branch of the service rendered. At the termination of the war, the first thing done was to restore telegraphic communication as quickly as possible. The number of Egyptian employés available at that date was very small; but about the 25th of August everything was put right as regards the Egyptian lines between Port Said and Ismailia. The Egyptian clerks are only capable of sending foreign messages at a rate of five or six words a minute. This was found to be quite insufficient for the purposes of the army, consequently considerable delays were occasioned. During the campaign, field sounders with relays, were placed at Geneffeh, Fayid, and Serapum, and also at the headquarters at Ismailia. Of the three wires between Ismalia and Kassassin one was employed for railway purposes.

An important part played by the field telegraph was the putting into communication of the flanks of the advancing columns. As use was made in every case where possible of the existing lines, these were reconnoitred during the night by cavalry; the wires were found pulled down in several places, but one wire proved to be good throughout. When Kassassin was occupied, as is usually the case in Egypt, the office was found to be in great confusion, and owing to the general disarrangement of the leading in wires, considerable difficulty was found in putting matters straight, but after a short time, calls were obtained on the Cairo and Ismalia circuits, which proved to be Egyptian. One great source of difficulty in working was owing to the drying up of the batteries. Immediately after the battle of Tel El Kebir the block of message work was very great, and great delays necessarily occurred. One very important use of the telegraph was in connection with the railway working, and owing to the great care exercised by the non-commissioned officers and men, the trains were despatched without any accident occurring. The proper management of the railway telegraphs by the station [illegible] a point of great importance, especially when a large num[illegible] of messages are received, and when the lines are in a fa[illegible] It was stated that in many cases messages which re[illegible] the departure of a train often arrived at their destina[illegible] a considerable time after the arrival of the train to wh[illegible] they referred. The Norwich accident, Lieut.-Col. WEB[illegible] pointed out, was entirely due to the want of good mana[illegible] ment on the part of a station-master.

Lieut.-Col. WEBBER then explained the arrangemen[illegible] military Morse instrument. This can be used [illegible] "open" and "closed" circuit working, or it c[illegible] relay. The close circuit principle was a ve[illegible] and as regards the extra expenditure of b[illegible] which was occasioned by its use, this was [illegible] great as was usually supposed to be the cas[illegible]

The general equipment for the telegraph service sent to Egypt was the best ever arranged.

The insulators employed were of ebonite, with brass caps, in which was a groove; the wire was placed in this and then securely bound; ebonite shackles, with brass ends, were also used. The poles were painted with black and white bands, which were very useful, as it was a point of much more importance that the invading force should be able to see the line than that the enemy should not see it.

The military Morse instrument proved to be most satisfactory; its coils were wound to a resistance of 300 ohms, and the galvanometer to 26 ohms; the same was the case with the field sounder. The apparatus is provided with a good lightning protector, and all the connection wires under the base board are indicated on the top by slips of coloured wood.

The portable batteries used were of the Leclanché agglomerate form, sealed up by a tar mixture; this, however, was found to melt by the extreme heat of the climate. It is not an entirely satisfactory battery, since on a closed circuit it soon runs down.

As it is important that the line of telegraph be kept in good order constant inspection is necessary; in Africa this inspection was made two or three times a day, as pack animals caused constant breaks. Properly speaking, a line ought to have the poles well bedded and strongly stayed, but this is seldom done, owing to time being limited. The wire used was stranded.

Lieut.-Col. WEBBER then stated that as the result of practical experience, he considered that the wire should be made up into ¼-mile coils, as the ½-mile lengths were too heavy to be handled easily. The climbing of the poles was very laborious work, and to make it as easy as possible he considered that the spikes on the climbing irons should be on the inside of the leg instead of the outside as was usually the case.

With regard to battery maintenance in hot climates, Lieut.-Col. WEBBER exhibited a six-cell Leclanché battery in a wooden frame, designed by Professor Fleming. The cells of this battery were of "insulite," and were sealed at the top. The zinc plate was fixed in a groove, and each cell was divided by a porous partition, one chamber containing the zinc-plate, and the other the carbon-plate in manganese and carbon fragments; the latter was filled with a bichromate of potash and sulphuric acid solution. The insulite was not affected by heat; it could even be boiled with impunity.

During the 15 days of active operations in Egypt 26 offices were open and 5,000 messages were sent, a large proportion being transmitted ones. In some offices 150 to 200 messages a day were despatched. The head office at Ismalia served as the central office.

Classification of the messages is very necessary, as the important ones require priority of transmission; this classification requires considerable judgment. Many of the messages which had to be despatched were in cipher from the Admiralty. These were transmitted with wonderful accuracy owing to the good training which the telegraph staff had undergone in the postal telegraph service in England.

Lieut.-Col. WEBBER then referred to the work of Col. Bolton with reference to visual signalling, which was the handmaid of telegraphy.

On the restoration of peace, the repairs of the State telegraphs were at once undertaken, and by September 22nd everything was as nearly as possible all right, though it will take some time to get matters perfectly straight.

The fire at the Cairo railway station destroyed 15 wires, the chief destruction being caused by the fall of houses. [As [illegible]rds the division of telegraphs into classes, it is generally [illegible] that this refers to difference of *matériel*.]

[illegible]Col. WEBBER then referred to the use of the [illegible] "line of communication" which had come into [illegible]use since the Franco-German war. There was no [illegible] for supposing that the line of communication was [illegible]t from any other in the army. The *matériel* employed [illegible]nded very much upon the nature of the country through [illegible]h the line was to pass. He expressed a hope that the [illegible]f the expression, "line of communication," would be [illegible]d, as it was as inconsistent as division of maintenance [illegible] be, or as having a distribution of electricity for [illegible] purposes without a centre.

The use of the military telegraph required very great discretion, as its chief use was to transmit orders, and not for general purposes.

In the discussion which followed the reading of the paper,

Mr. VARLEY said that he would remind Col. Webber that in 1854, previous to Major Bolton's taking up the subject, the Electric and International Telegraph Company had sent out to the Crimea a complete telegraph equipment under General Neale.

Mr. ANSELL, in proposing a vote of thanks to Lieut.-Col. Webber for his paper, said that a mistake had been made in the statement that the Eastern Company's line was maintained by the State; the line was kept in order by the company's own staff. With regard to the line of communication being kept open he would point out that there was a head-quarters in England as well as in Egypt. Mr. PATEY seconded the vote of thanks, which was carried unanimously. The meeting then adjourned.

PHYSICAL SOCIETY.—NOVEMBER 25th.

Prof. CLIFTON, President, in the Chair.

A PAPER by Mr. William Ackroyd, on "Rainbows produced by Light reflected before entering the Raindrops," was read by the SECRETARY. The author investigated mathematically the rare phenomenon of three bows, and inferred that it would generally take place about sunrise or sunset. Mr. LECKY thought the effect had a simple explanation. It might be said to be due to two suns, one (reflected) appearing to be below the horizon.

Mr. SHELFORD BIDWELL gave an account of some experiments he had made to test the theory of Dr. James Moser, that the action of a selenium cell under light was due to the heat-rays making a closer microphonic contact between the selenium and the metal electrodes, by expanding the material. He submitted selenium cells to dark heat-rays, and found their resistance to *rise*. Under light-rays, however, their resistance fell. He therefore concluded that Mr. Moser's theory was erroneous, and that the fall in resistance due to the light-rays is the differential result of the rise due to heat, and the fall due to light. He also explained the "fatigue" of a selenium cell by use, as caused by its increase of temperature. When the cell cooled again the fatigue disappeared.

Dr. MOSER and Professor G. C. FOSTER made remarks on the paper, the former suggesting experiments to test the reversibility of the effects observed by Mr. Bidwell, and the latter seeking to reconcile Mr. Moser's theory with the new data.

Dr. JAMES MOSER then read a paper on a "General Method of Strengthening Telephonic Currents." This consists in forming a primary circuit of the telephone transmitters in derived circuit, a set of induction bobbins in derived circuit, and a charged secondary battery; the whole circuit having a very low resistance. Each primary bobbin has a secondary wound over it, and these secondaries are connected "in quantity" to the telephone line, which has at its remote end a set of telephones in derived circuit to the earth or return wire. In this way one line-wire serves to supply a large number of separate telephones—a hundred being employed by Dr. Moser to transmit music from the Hippodrome in Paris to the Place Vendôme. The system is applicable to long lines, and the induction noises are reduced by the subdivision among the separate telephones.

AMERICAN ELECTRICAL QUOTATIONS.—Telegraph, telephone, and electric light stocks were quoted on Wednesday, November 15th, as follows:—

Western Union Telegraph	81⅝
Mutual Union Telegraph	26
American Cable	68½
American Bell Telephone	179
Edison Electric Light	500
U. S. Electric Light	105
Fuller Electrical	23
Lugo Dynamo-Electric	150

EXPERIMENTS MADE AT THE PARIS ELECTRICAL EXHIBITION ON ELECTRIC LIGHTS AND MAGNETO AND DYNAMO-ELECTRIC MACHINES.

(By MM. ALLARD, JOUBERT, T. LE BLANC, POTIER, and H. TRESCA.)

THE results of these experiments have just been presented to the Académie des Sciences in four distinct series, of which the titles, with the date of presentation, are given below :—

Sitting of October 30th : Continuous current machines and regulators.

Sitting of November 6th : Alternating current machines and regulators.

Sitting of November 13th : Electric candles.

Sitting of November 20th : Incandescent lamps.

We thought it best to await the complete publication of this interesting work, although a little late, in order to present a succinct and faithful *résumé* of it to our readers, and to bring to light some direct inferences derived from the figures found by the Commission.

But it is important, first of all, to define some slightly novel terms used by the Commission to note the different functional elements, and to allow of making useful comparisons.

The unit of work adopted is the cheval-vapeur, whose value is 75 kilogrammetres per second. It is nearly equal to the English horse-power, which is, however, rather greater. Here is the exact relation :—

One cheval-vapeur = 75 kilogrammetres per second = 7,360 meg.-ergs.

One horse-power = 75·9 kilogrammetres per second = 7,460 meg.-ergs.

Resistances, electromotive force, and intensity are calculated in ohms, volts, and ampères. The following are the definitions of the special terms :—

Cheval électrique : Electrical energy produced by a generator calculated in chevaux-vapeur.

Cheval d'arc : Electrical energy consumed by an arc lamp in chevaux-vapeur.

Total mechanical return : Relation between the total electrical power furnished by the machine and the effective motive-power expended on the machine.

Mechanical return of arcs : Relation between the electrical power consumed by the arc or arcs and the effective motive-power expended on the generator.

Electrical return of arcs : Relation between the electrical energy consumed by the lamp or lamps and the total electrical energy furnished by the machine.

Luminous intensity : Measured in *Carcels.*

1 Carcel = 9·5 standard candles.

The Commission has only taken into its calculations the value of the photometric intensity designated under the name of *moyenne sphérique.* It supposes the luminous intensity measured in every direction and equalised in such a manner as to be the same in every direction ; this is the only method which represents the total of the phenomena, and which, with this title, can be compared in a rational manner with the various elements which produce this intensity.

There is no doubt that the figures given by manufacturers are much higher than those which correspond to the mean spherical intensity, since, in general, the luminous intensities are taken in the direction where the intensity is greatest.

I. CONTINUOUS CURRENT LAMPS AND MACHINES.

Table I. gives the whole of the results furnished by the continuous current machines supplying one or several arc lamps. The table refers to 13 series of experiments upon different systems with a number of variable lamps.

The mechanical observations give the speed of the machines in revolutions per minute, and the effective motive-power expended by each of them. It is to be regretted that these observations are not accompanied in each case by the extreme diameter of the induced revolving parts, which [illegible] of calculating a very important element—the absolute speed at which the induced part is turned. By comparing the absolute value of this speed with the total mechanical result, and with the mechanical result of the arcs, it would have been easy to observe the influence of great speed of revolution ; from this point of view the number of revolutions per minute furnishes no indication and presents, consequently, only a secondary interest. The electrical observations show us the actual practical limits between which electric lights will act, according to the size of the pencils of carbon and the volts and ampères supplied to the light. The intensity varies from 109 ampères with pencils of 20 millimetres in the lighthouse lamps to only 9·5 ampères in the Brush lamps.

The figure relative to the fall of potential of the lamp in volts is remarkable for its relative constancy, since it only varied from single to double—from 58 volts for 90 ampères to 32 volts only for the Weston lamps of 23 ampères. This low figure of 32 volts corresponds to a *short* arc, that of 58 volts to an arc relatively *long ;* the first shows that the contra-electromotive force developed in the arc is very variable, still very badly defined, and that, in some cases, it may be notably lower than 32 volts.

The photometric observations show that the arc produces all the luminous intensities from 1,000 carcels to only 40 carcels, according to the size of the carbons and the electrical energy expended.

The comparison of the results undoubtedly furnishes the most valuable indications. The comparison between the total mechanical result of the machines shows the great superiority of the Jurgensen machine, which transforms into electrical energy 97 per cent. of the mechanical work which is supplied to it, but there is a counteraction to this advantage, for we only find in the arc 32 per cent. of the mechanical power expended ; that is to say, less than any of the others, which furnish in the arc as much as 70 and even 77 per cent. of the mechanical force expended. These differences arise from the external resistances of the circuit being out of proportion to the internal resistances of the machines, and also from the passive resistances proper to each system.

This fact is especially noticeable when one compares the figures of the four last lines of the table. It is seen, for example, that the Weston machine, supplying ten lights, produces more light per mechanical horse-power than the large lighthouse lamps supplied by a Gramme machine. The comparison of these figures would tend to make one believe that *one gains by division of the light,* since the small Weston lamps furnish 65·3 carcels per horse-power, and the lighthouse lamp only 60 carcels. This is not the case, however, and when we compare the electric energy consumed by each of the lights, we find that the large one produces 128·8 carcels per arc horse-power, whilst the small produces only 85. This is because the number of carcels per mechanical horse-power combines the result of the machine and the result of the lamp, whilst the number of carcels per arc horse-power comprises only the expenditure of electrical energy of the lamp. Thus, for example, in experiment VII. the result of the Gramme lamp is one of the best, not to say the best of all, since it produces 121·6 carcels per arc horse-power ; we only find, however, 61·8 carcels per mechanical horse-power. This is because, under the conditions of the experiment, the total mechanical result was only 0·62. It was found, therefore, in this particular case that a machine in bad conditions of working was supplying lamps placed, on the contrary, in excellent conditions.

The practical results of these experiments are as follows :—

All machines transform, on an average, 85 per cent. of work expended into electrical energy.

We find in single lights 47 per cent. in electric energy of the mechanical work expended upon the machine, 60 per cent. in the lights arranged from three to five in tension, and up to 70 per cent. when from 10 to 40 lamps are placed in circuit.

The return in carcels per mechanical horse-power is nearly the same in every case, or, on an average, 35 carcels per mechanical horse-power, whilst the arc horse-power furnishes, on an average :—

120 carcels in lights of from	800 to 1,000	carcels.
100 „ „	250	„
71 „ „	40	„

The relation of the intensity of the current to the number of carcels presents also some interest. We find, on an average, that—

lights from 800 to 1,000 carcels produce 9 carcels per ampère.
250 to 300 " " 6 " "
100 " " 5 " "
40 " " 4 " "

One can thus deduce from table I. the most suitable relation between the diameter of the carbons and the current which traverses the arc. This calculation, which the committee has not made, would furnish, however, interesting information, and would allow of appreciating in some measure the photometric advantage in the employment of two fine pencils burning very rapidly.

TABLE I.

RESULTS OF EXPERIMENTS MADE WITH CONTINUOUS CURRENT GENERATORS AND LAMPS.

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
——	Formulæ.	Gramme. 1 Lamp.	Jurgensen. 1 Lamp.	Maxim. 1 Lamp.	Siemens. 1 Lamp.	Siemens. 2 Lamps.	Bürgin. 3 Lamps.	Gramme. 3 Lamps.	Gramme. 5 Lamps.	Siemens. 5 Lamps.	Weston. 10 Lamps.	Brush. 16 Lamps.	Brush. 40 Lamps.	Brush. 38 Lamps.
1. MECHANICAL OBSERVATIONS.														
Speed of generators, revolutions per minute	...	475	800	1017	737	1330	1535	1695	1496	826	1003	770	700	705
Effective work of motor, horse-power	T	16·13	21·68	4·07	4·44	5·31	5·32	8·11	8·00	5·05	13·01	13·39	29·96	33·25
2. ELECTRICAL OBSERVATIONS.														
Resistance of generator, ohms ...	...	·33	·45	·70	·66	1·68	2·80	·52	4·57	7·05	1·88	10·55	22·38	22·38
" circuit without lamps, ohms ...	...	·10	·82	·25	·12	·13	1·50	1·25	·62	4·50	1·50	2·56	2·60	7·90
Total resistance, ohms	R	·43	1·27	·95	·78	1·81	4·30	1·77	5·19	11·55	3·38	13·11	24·98	30·28
Intensity of current, ampères ...	I	109·2	90	33	35	26·2	18·5	19·0	15·3	10·00	23	10	9·5	9·05
Fall of potential at lamps, volts	E	53	58	53	53	44·5	41	53	49·8	47·4	32	44·3	44·3	44·3
Work in total circuit	$\frac{RI^2}{75g}$	6·97	13·99	1·41	1·29	1·69	2·00	·87	1·65	1·57	2·43	1·79	3·07	3·72
" one lamp	$\frac{EI}{75g}$	7·87	7·09	2·37	2·52	1·59	1·027	1·369	1·04	·64	1·00	·60	·573	·573
" all lamps, horse-power	t	7·87	6·97	2·31	2·52	3·18	3·08	4·11	5·20	8·20	10·00	9·60	21·88	20·79
Total electrical work	T^1	14·84	20·96	3·72	3·81	4·87	5·08	4·98	6·85	4·77	12·43	11·39	24·95	24·51
Mean electromotive force ...	$nE + RI$	102	172	84	80	136	203	193	328	353	398	840	2009	1971
3. PHOTOMETRIC OBSERVATIONS.														
Diameter of carbons, inches ...	...	·79	·91	·43	·71	·55	·51	·55	·47	·39	·35 & ·39	·43	·43	·43
Horizontal luminous intensity, carcels	...	952	607	246	210	142	50	155	112	67	92	37	63	63
Horizontal luminous intensity, maximum carcels	...	1960	...	465	805	537	227	357	184	72	154	76	78	78
Average spherical luminous intensity	l	966	688	239	306	205	82	167	102	52	85	38	39	39
Average total intensity	$L = nl$	966	688	239	306	410	246	501	510	260	850	608	1500	1482
4. PERFORMANCES.														
Total mechanical work	$\frac{T^1}{T}$	·92	·97	·91	·86	·92	·95	·62	·86	·94	·95	·85	·83	·73
Mechanical work in arc	$\frac{t}{T}$	·43	·32	·57	·57	·60	·58	·51	·65	·63	·77	·72	·73	·62
Efficiency of arc	$\frac{t}{T^1}$	·53	·33	·62	·66	·65	·61	·83	·76	·67	·80	·84	·87	·85
Carcels per mechanical horse-pwr.	$\frac{L}{T}$	60	31·7	58·7	68·9	77·2	46·2	61·8	63·8	51·5	65·3	45·4	52·1	44·4
" electric horse-power..	$\frac{L}{T^1}$	65·1	32·8	64·2	80·3	84·2	48·4	100·4	74·5	54·6	68·4	53·4	62·6	60·5
" arc horse-power ...	$\frac{L}{t}$	128·8	98·7	103·5	121·4	129·3	79·9	121·6	98·1	81·3	85·0	63·3	71·7	71·4
" ampère	$\frac{l}{I}$	8·85	7·64	7·24	8·74	7·82	4·43	8·79	6·67	5·20	3·70	3·80	4·11	4·11

II. ALTERNATING CURRENT MACHINES AND LAMPS.

The experiments of the Committee relating to these lamps and to these machines are comparatively few, for they were only made upon three types of lamps and two types of machines :—

1° Méritens machine, supplying 1 Serrin lighthouse lamp.
2° Méritens machine " 5 Berjot lamps.
3° Siemens machine " 12 differential lamps in 3 circuits.

In the first case the mechanical and photometric effects only could be measured. The lighthouse lamp produced a light whose mean spherical intensity was 931 carcels for an expenditure of mechanical power equal to 11·7 horse-power, which represents 79·6 carcels per mechanical horse-power, against 60 carcels for lights of equal power with a continuous current. This experiment shows that the electric power is better utilised in alternating current lighthouse machines than in continuous current machines, but it creates no superiority in favour of alternating currents, since in Berjot lamps of 150 carcels the result is 59·7 carcels per mechanical horse-power, and it falls to 33·3 carcels in the differential Siemens lamps of 39 carcels. Alternating currents have, therefore, shown an inferiority of result in the case of lights of low power.

III. ELECTRIC CANDLES.

By way of definition, one includes under the name of *candles* all lights in which the carbons are placed parallel. Experiments were made upon the Debrun, Jahlochkoff, and Jamin candles. The experiments on the Debrun candle are very incomplete. It was proved by the experiments that with 10 ampères and 50 volts difference of potential at the base of the candle, the light produced is 31·6 carcels per arc horse-power and only 14 carcels per mechanical horse-power. The Jablochkoff candle (pencils of 4 millimetres) works with 42 or 43 volts difference of potential and 7·5 to 8·5 ampères. It produces from 46 to 51 carcels per arc horse-power, and from 31 to 35 carcels per mechanical horse-power.

The working of the Jamin candle might almost be called electrical sleight of hand.

By placing 32 candles upon the machine, a current of 6·1 ampères and 77 volts difference of potential at the base,

lights of 16 carcels are obtained, with a result of 25 carcels per arc horse-power.

The most favourable conditions are obtained with 48 candles upon the machine. The current is 5·1 ampères, the difference of potential 69 volts, the power of each light 17·4 carcels, and the result per arc horse-power 36·4 carcels.

When 60 lamps are placed upon the machine the working becomes quite fantastic. The current is not more than 3·5 ampères and the difference of potential 74 volts. The power of each arc light is 9·4 carcels, and the return per arc horse-power 27·3 carcels. One may well ask what can be the practical interest of arc lights working with 3·5 ampères and 74 volts difference of potential, and what would be the steadiness of an arc light working in these conditions?

These few figures show that candles are transition lights, intermediate between regulators, properly so called, and incandescent lamps, giving lower results, and the employment of which recommends itself much more by the simplicity of their component parts than by their intrinsic value.

Without disputing the advantage of the automatic relighting of the Jamin candle, we come to a conclusion which, taking into consideration the figures of the committee, is the very opposite of that arrived at by themselves, that the Jamin candle is greatly inferior to the Jablochkoff candle, both as regards the number of carcels produced per mechanical horse-power, and that of the carcels produced per arc horse-power, however superior the electrical result of the arcs may be. This is because the Jamin candle acts *too exactly*, if one may use this expression, that is to say, with the intensities of current too near the acceptable limit. In these conditions, the small superiority resulting from a better electrical result is far from compensating for the loss of light resulting from the employment of an arc of too small volume compared with the dimensions of the pencils of carbon between the extremities of which the arc plays.

IV. Incandescent Lamps.

The experiments undertaken upon incandescent lamps in closed globes have shown that we must not require from them a luminous power much greater than two carcels, at least as regards the types represented at the Electrical Exhibition.

The experiments undertaken by a special sub-committee, and the results of which were published in the Electrical Review of 17th June, 1882, page 434, have given practically the same results as those of the principal committee.

We re-produce in the subjoined Table II., the results which relate to the figures of the principal committee; the measurements have been more especially taken from an electrical point of view. The mean spherical luminous intensity is, for the Maxim lamp, 0·74 of the horizontal intensity when opposite, and 0·78 of the horizontal intensity at 45°. In the Edison lamps, the mean spherical intensity is equal to 0·98 of the horizontal intensity when opposite.

The horizontal intensity at 45° is equal to 1·33 of the horizontal intensity when opposite.

For Lane-Fox lamps, the mean spherical luminous intensity is equal to 0·58 of the horizontal luminous intensity when opposite, and to 0·69 of the horizontal luminous intensity at 45°.

The Swan lamps had similar co-efficients.

Table II. Experiments on Incandescent Lamps.

	Maxim.	Edison. 16 candles.	Lane-Fox.	Swan.
Ohms (under heat)	43	130	28	31
Volts	75	91	50	48
Ampères	1·74	0·7	1·77	1·55
Kilogrammetres	13·23	6·50	8·95	7·62
Mean spherical luminous intensity	2·80	1·57	1·64	2·19
Carcels per arc horse-power ...	15·89	18·12	13·74	21·55

For lights of 1·2 carcels (13 candles) one could only reckon upon an effective lighting (mean spherical intensity) of 12 to 13 carcels per arc horse-power, and about 10 carcels per mechanical horse-power by means of incandescent lamps.

General Conclusions.

Regulators furnish about	100	carcels per arc horse-power.
Candles ,, ,,	40	,, ,, ,,
Incandescent lamps ,,	10	,, ,, ,,

The economical values of these three systems are, therefore, about in the ratio of the numbers 1, 3, and 7, seeing that in each system the most intense lights always give the best result.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," Electrical Review, at above address.

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CORRESPONDENCE.

SECONDARY BATTERIES.

To the Editors of The Electrical Review.

Dear Sirs,—At one of the last meetings of the Academy of Science, Paris, M. G. Planté described a new method of forming secondary batteries, and being now actively engaged in the practical applications of accumulators, I thought that a few remarks might interest your readers upon this method. Following the recommendation of M. Planté, I have myself experimented this method at the laboratory of M. de Kabath, Paris, and regret to say, with all due respect to the great scientist and *savant*, that I cannot agree with his conclusions.

This method, as well as the one previously proposed by M. Planté, viz., of heating the solution while the elements are being formed, do not present any real practical advantages. No doubt both methods as applied to the formation of a Planté cell will quicken such formation, but reducing the lead, either by heating the solution or attacking the surface of the lead by strong nitric acid, seems to me to upset the very aim pursued through the whole scientific researches of M. Planté.

In producing an artificial formation of peroxide and reduced lead, the new Planté cell will follow the same physical and chemical laws as do all other secondary batteries where the formation of the peroxide and reduced [illegible] are mechanically attached.

One of our leading scientists, who was [illegible] endorse M. Faure's invention in the scient[illegible]

on several occasions expressed his opinion that while by adding the peroxide mechanically, the first results of a secondary battery so formed are exceedingly satisfactory, yet the action of the current combined with the action of the sulphuric acid penetrating to the heart of that mechanically attached peroxide, at a given moment (which we might consider as about two months for a secondary battery in active service) produces a new action of the current on the lead blade itself, which then gets peroxidised on its entire surface with a layer of crystalline peroxide, as can be distinctly seen in all the batteries deriving directly from M. Planté in which the formation is made by the sole action of the electric current. This layer of crystalline peroxide by its molecular formation being entirely different from the peroxide mechanically attached, they become by the action of the current independent of each other, and as the oxide, when not in direct contact with the metallic blade is virtually a non-conductor, it becomes in such a case an useless element and a dead weight.

I thought it necessary to give these remarks before expressing any definite opinion upon this new method of forming secondary batteries as described by M. Planté, and which throws us back to all the defects of the batteries wherein the peroxide is mechanically attached, for a layer of peroxide obtained by charging the molecular formation of the lead will follow exactly the same laws.

To conclude, I will say that all the tests that have been made by myself and others have fully demonstrated that as long as lead will be used to form the elements of secondary batteries *the only safe and practical way of forming the layers of peroxide is by the action of the electric current itself.*

The only recommendation I can make is to use 20 per cent., even 25 per cent., and sometimes as high as 30 per cent. of acid, instead of 10 per cent., as has been adopted by M. Planté.

This solution cannot be applied where felt, parchment paper, or any other similar perishable substance is used, and from this I conclude that the problem at present to solve is to obtain *the maximum surface to the minimum weight of lead.*

Respectfully yours,
CHAS. W. FARQUHAR.

Barcelona, Spain.
November 22nd, 1882.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—In reply to your request for information respecting the manner in which the classes on Electrical Engineering are conducted at the City and Guilds of London Institute, the experiments are *not* carried out under the direct supervision, either of the professor or his assistants, students being left to find employment for themselves. The number of students is far in excess of the accommodation: one may see a dozen to twenty striving to read one am-meter and wondering what it is all about. Of formulæ there is a good supply, but practical examples are yet in the future. The classes are much too large to allow of individual attention, and such is not to be desired until the assistants are a wee more courteous. Home lessons *nil.* The only experiments I have seen performed in view of the entire class consist of the deflection of the leaves of a condensing electroscope by means of a stick of shellac rubbed with the skin of a defunct puss, and the production of a spark by means of an induction coil.

Last session we were shown a long-suffering cylindrical condenser of calculable capacity which ornamented the right-hand corner of the table for a considerable period. This, together with the exhibition of a 0·3 m. f. condenser and a signalling key, makes up the sum of the experiments (?).

I agree with your correspondent F. W. F., except as to the experiments. Does he attend the Monday evening class? If so, surely he is in error? I have given up the laboratory altogether, for it is a mere waste of time when half-a-dozen bewildered students are each trying to measure the resistance of the same battery with the same apparatus at the same time, alarming results being the consequence. I am in hopes that when we are located in the new building things will mend, if not I shall evaporate.

Yours truly,
SEA BOOTS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS.—In reference to the above I should feel obliged if you would insert the following remarks on F. W. F.'s letter which appeared in your last issue. As, in addition to the professor, there are three demonstrators on duty in the laboratory of the Physical Department of the City and Guilds of London Technical College, Finsbury, on Monday and Friday evenings, I cannot understand how F. W. F. can affirm that "the only assistance the student receives as a rule in carrying out the experiments is from the written instructions attached to the instruments." Each of these demonstrators is only too glad to smoothe away any difficulties the student may meet with. Again, since a considerable time is regularly spent in overlooking "the home lessons" done by the students, I presume that your correspondent means by his surprising statement that "no home lessons are given to the students to prepare," merely that there are no passages from text books given to be read-up. In fact, leaving out of account the questions given during the lecture to be worked out by the students before the next lecture, if every student regularly wrote up his lecture notes, worked out the results of the experiments he has himself made in the laboratory in accordance with the written instructions urging him to do so, and lastly, graphically recorded the results of each experiment on the sheets of squared paper given him *gratuitously* for that purpose, he would, no matter how ardent his desire to work at home, have quite as many "home lessons" as he could possibly do.

That the temporary laboratories are immensely overcrowded, in consequence of the unexpectedly rapid increase in the number of students attending the Electrical Engineering Classes at Cowper Street, is only too obvious to every one; but any student who is unwilling to put up with some inconvenience until the opening (unavoidably postponed this term) of the new Finsbury Technical College, on the building and fitting of which the Institute is spending many thousands of pounds, should remember that he always has it in his power to slightly diminish the present crowding of the temporary laboratories.

Very truly yours,
ARTHUR C. COCKBURN,
Chief Demonstrator.
Physical Department, City and Guilds of London College.

INCANDESCENT AND ARC LAMPS ON THE SAME CIRCUIT.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Allow me to make a few remarks in reference to the recent articles which have appeared in your journal on the subject of incandescent and arc lamps on the same circuit.

With most systems of electric lighting the union of these two kinds of light is impracticable, but by the Gülcher low tension system, with the arrangement of parallel circuits, it is perfectly easy to light both incandescent and arc lamps by the same dynamo machine. All the installations we have hitherto had to carry out for our customers have been made with that combination, to their perfect satisfaction, thus proving at a glance that our system meets the requirements of the public.

If the dynamo machine is running regularly at its proper speed, there is not the slightest fluctuation perceptible in the incandescent lamps, and the light is just as steady as if they were worked independently of the other.

Everybody can see this at our Battersea works, where a single No. 4 dynamo works 4 large lamps of 2,300 candle-power each and about 50 incandescent lamps of 20 candle-power each.

The reason why our system is so perfectly suitable for this combination is simple enough. It is a well-known fact that so long as the proper and regular speed of the Gülcher dynamo is maintained, the electromotive force remains nearly perfectly constant, while on the other hand the quantity of the current varies in direct proportion to the number of lights and in inverse ratio to their resistances. Therefore, even if the resistance of one of the arc lamps varied considerably, owing to its not working properly, the fluctuations of the light would not be perceptible in the in-

candescent lamps on other circuits, as only that one branch circuit would be supplied with more or less current, according to the variable resistance of the arc lamp, while the current would not vary at all in the incandescent lamp circuits, but would remain constant as long as the speed of the dynamo machine was regular; and even in case the resistances of two or more arc lamps varied and absorbed more or less current in their branches at a time, the current in the incandescent lamp circuits would still remain constant.

I am, dear Sirs, yours faithfully,

R. J. GÜLCHER,

Electrician of the Gülcher Electric Light and Power Company, Limited,

121, Bishopsgate Street Within, E.C.
November 24th, 1882.

NOTES.

Notice to Readers.—Subscribers are hereby notified that in future the supply of back numbers of the Electrical Review cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

The Electric Light.—Last Monday night the electric light was exhibited for the first time in Port Elizabeth by the South African Brush Electric Light and Power Company. Six lamps were lighted—three in Market Square and three on the Hill, near the Port Elizabeth Club—at half-past 8 o'clock, and were kept lighted till 12 o'clock. A large concourse of people gathered together at both places to see the novelty, and all were much pleased with the brilliancy of the lights and the steadiness with which they burnt. What the relative cost of production may be we are not at the moment prepared to say, but about the brilliancy of the electric light, together with a softness it is difficult to describe, there can be no doubt. We presume the company will now make some proposal to the municipal authorities in regard to the expense of lighting the town by the Brush light system.

We have been favoured with the following particulars of the electric light now being exhibited in Port Elizabeth:—The engine-room is at the Phœnix Works (Messrs. Mangold Bros.), the engine being of 7 horse-power, made by Messrs. Hornsby and Sons, Grantham, and which drives the generating machine at over 900 revolutions per minute, the speed of the engine itself being 180 revolutions per minute. The wire is carried to three lamps in the Market Place, and thence to three lamps round the Vley, the total length of the circuit being about one mile.

The lights will be exhibited for one month, from one hour after sunset to 12 o'clock.

The present exhibition has been erected under the superintendence of Mr. R. L. Cousens, electrician of the South African Brush Electric Light and Power Company, Limited. —*E. P. Herald, October 18th.*

The Electric Light in South London.—The Electric Lighting Committee of the Rotherhithe Vestry reported that at the adjourned conference of representatives of local bodies a resolution was passed in favour of the vestries and boards lighting their own districts. The committee recommended that a special meeting of the vestry be called to consider the whole question, and that in the meantime the clerk obtain information from the various companies as to their terms for supplying the public and private lighting of the parish.

The recommendation was adopted.

In reply to Mr. Simmons at the Camberwell vestry, the clerk (Mr. J. W. Marsden) stated that applications had been received from electric lighting companies for four provisional orders [illegible] licence.

Mr. Middlemass, chairman of the general purposes committee, brought up a report recommending that permission be given to the committee of the International Electric and Gas Exhibition at the Crystal Palace, on their application, to use the lamp-posts on the Crystal Palace Parade for the purpose of exhibiting improved lights, and that the same be erected and removed under the supervision of the surveyor, and the old burners and lanterns reinstated to the satisfaction of the vestry; and that an agreement be prepared by the vestry clerk in accordance with these terms.

The recommendation was agreed to.

A letter was received by the St. Saviour's Board of Works from the vestry of Camberwell, stating that at an adjourned conference of delegates it was resolved to recommend the local boards to apply for licences under the Act. A letter was received from the vestry of St. George, Hanover Square, on the same subject. The communications were referred to the Lighting Committee.

The Electric Lighting Committee of the St. Olave's Board of Works reported that at the adjourned conference of delegates from South London parishes, a resolution was passed in favour of the local authorities keeping the power to light the parishes in their own hands. The committee also reported that they had received a tender for providing the Lane-Fox system at £3 per lamp per year, the board to have the power at the end of five years of purchasing the stock at the original cost. On the motion of Mr. Scovell it was resolved: "That a special meeting of the board be convened for Tuesday, the 9th January, 1883, at 12 o'clock, to consider the expediency of applying to the Board of Trade for a licence to supply electricity for public and private purposes within the area of the district." The motion was seconded and agreed to.

The Metropolitan Brush Electric Light and Power Company *v.* Cruickshank.

(Before Mr. Justice Field and Mr. Justice Stephen.)

This was an action by the company to recover a sum of £20 as the balance of the amount due on ten shares in the company. Bringing the action in the high court, they applied for judgment under the Judicature Act (Order XIV.) as in an action there could be no defence. The defendant, in answer to the application, swore that a certain pamphlet produced was a pamphlet or prospectus of the company, which had upon its title-page these words, "Sole concessionaires for erecting Brush Arc and Lane-Fox Incandescent lights in London and Westminster and the whole of the metropolitan postal district." And then he swore that in May last "he applied for and had allotted to him ten shares of £5 each in the company, and paid £10 upon application, therefore relying upon the company and upon the faith of the representations by the company; and that had it not been for such statement he should not have applied for any of the shares; and that he had since ascertained that such statements were untrue, and that the Anglo-American Brush Electric Light Company and the British Electric Light Company had at that time the right to erect the lamps referred to within the district; and that he believed that the statements referred to were known by the company to be untrue." The Judge at Chambers was not satisfied with this affidavit, and the defendant made a further affidavit that he first became aware that the statement referred to was untrue, a day or two before the action was brought. The learned judge (Mr. Justice Watkin Williams) was still not satisfied with the affidavit as not distinctly showing that the defendant had seen and read the pamphlet before he applied for his shares, and so he gave leave to enter judgment for the sum claimed. This was an appeal by the company from that decision.

Mr. Bower appeared for the company; Mr. Rose-Innes for the defendant.

The Court, in giving judgment yesterday, said they thought that a defence was so far sufficiently stated as to require that it should be tried. They were not now to decide whether or not it was true in fact, but whether it was substantially stated and alleged, and they thought that it was. The defendant had sworn that he had applied for and taken the shares "relying upon, and on the faith of," the representation referred to, and that just before the action he had found out that it was false and fraudulent, and he was entitled to have that question tried. A party who after he had entered into a contract discovered that he had been induced to enter into it by means of fraud was entitled to set up that ground as a defence. The order for judgment, therefore, must be set aside, especially as it was shown that this action—only for £20—had been brought in the high court for the very purpose of thus obtaining judgment summarily.

The Electric Light at the Birmingham Cattle Show.—The Birmingham *Daily Post* of the 28th ult. says:—"Perhaps one of the first things to attract the attention of visitors in the implement department is an installation of electric light by Messrs. Smith and Chamberlain, of the Solar Works. The special permission of the Council has been given for this display at Messrs. Tangye's stands, No.

10 and 24, and the installation is invested with additional interest and importance by the fact that this is the first time the Edison light has been shown in Birmingham. The results achieved are such as to excite considerable admiration, and to show beyond dispute the ease and advantage with which the electric light may be adapted to domestic use. There is no attempt, in consequence of the limited space, to illuminate any extensive area, but simply an endeavour to show what may be done by the electric light in rooms such as private libraries, picture galleries, dining-halls, drawing-rooms, &c. The light is produced by two of Edison's dynamo-electric machines, each driven by Messrs. Tangye's coupled gas-engines of 2½ horse-power (?). Hitherto it has been difficult with gas-engines to secure a steady electric light owing to the intermittent motion, but in the present invention there are two impulses at each revolution, which causes a perfectly steady working, and in no way disturbs the light. One of the dynamos is equal to supplying sixty lights, and the other fifteen, and they convey the current to four chandeliers, ten pendants, a three-light bracket and a hall lamp. The chandeliers are of such artistic and elegant design that in themselves they are well worth seeing. The illumination is brilliant without being so intense as to be painful to the eyes, and its steadiness and entire absence of heat should make it exceedingly desirable for the purposes to which Messrs. Smith and Chamberlain show its adaptability."

THE LANE-FOX LAMP.—The directors of the Anglo-American Brush Electric Light Corporation have placed the direction of the Lane-Fox Incandescent Lamp Department, Portpool Lane, in the hands of Mr. St. George Lane-Fox.

FITTINGS FOR THE ELECTRIC LIGHT, &c.—Messrs. Faraday & Son, of Berners Street, W., have, we believe, designed and manufactured the special fittings ordered for the Swan lamps that are being supplied to H.M.S. *Himalaya*. These are of a less fanciful type than those recently made by the same firm for the *Invicta*, the main requisite in a troop-ship being safeguards against tampering on the part of "larkers."

THE first instance of the employment of the incandescent electric lamp for the lighting of a West End shop-front is probably that of Mr. Mayall's, at the corner of New Bond Street and Grafton Street. Since September thirty-six Swan lamps, fed by a Gramme machine, have brilliantly illuminated the life-size photographs in the windows. The work has been carried out by the above firm, and special fittings have been designed representing a Renaissance allegorical sun, flanked by vines, from the tendrils of which the little bulb lamps are made to depend. The design is a complete departure from those in vogue for older illuminants, while the central feature of the sun has an appropriate reference to the photographic art.

THE electric light is, we understand, to displace the old sunburners in the theatre of the Royal Institution, Albemarle Street, during the forthcoming Christmas and Friday evening lectures. The Swan lamp is now festooned along the gallery front, being strung between the beaks of brackets representing a species of "swan with two necks." Other lamps are fixed in the circular roof, their light being directed by means of a parabolic reflector strongly upon the screen opposite the audience. It has been found that forty incandescent lamps thus disposed light the theatre as effectually as the 126 gas jets hitherto employed. The arrangement and details have been carried out by Messrs. Faraday & Son.

THE ELECTRIC LIGHT IN LONDON.—The electric lighting companies, says *The Building and Engineering Times*, are not disheartened by the failure of some of them to secure mercantile success, and a number have given notice of their intention to apply to the Board of Trade under the Act of 1882 to enable them to light the City by electricity. A fair field and no favour should, and we hope will, be the order of the day, but in the multitude of competitors there may be some inconvenience occasioned to the public. The feeling in the Commission of Sewers is that all future experiments must be made at the expense of the companies themselves, and not at that of the ratepayers.

ELECTRIC LIGHTING IN CROYDON.—Mr. Charles Lee, in writing to the *Croydon Chronicle*, says :—"That the whole problem of lighting by electricity has been solved by the 'Brush' or any other company is quite contrary to my conviction, and was never stated by me, in fact, I am fully persuaded we have only just touched the fringe of the subject, and that much more than we have now the slightest conception of will be accomplished in the (perhaps near) future, both as to lighting and locomotion. What I said was that the South Eastern (please to take due note of the name) Brush Electric Light and Power Company, Limited, were prepared to undertake the lighting of a certain part of Croydon at a price not exceeding that of gas. If they do this at a loss to their shareholders, that is a question to be settled among themselves; and with the guarantees Local Boards can demand there is nothing to be lost, but everything to be gained by the public of Croydon.

"I have been led to look into this subject as treasurer of the new Wesleyan church in the Lower Addiscombe Road, which it was desired to light by electricity; we tried in all quarters, but for the present we are blocked, I trust not for long. In the last number of the *London Gazette* will be found a notice of application to the Board of Trade for a Provisional Order by the South-Eastern Brush Electric Light and Power Company, Limited, which, if granted, will give to Croydon the great desideratum, the electric light."

ELECTRIC LIGHTING.—We understand that Messrs. Lewis, of Liverpool, are lighting up one of their houses with fifty Pilsen arc lamps, and they have appointed Messrs. Woodhouse & Rawson, of London and Belfast, contractors for carrying out the work.

ELECTRIC lighting experiments are about to be made at Aberdeen, as will be observed below, and every effort is to be made to enable the public to see the light at its best.

THE Liverpool Health Committee last week decided not to allow the further adoption of the electric light for shops in the town until the matter has been dealt with by the Council.

THE electric light, after a good trial, has been found to suit admirably the dye works of Messrs. P. and P. Campbell, Perth. The light is used in the four principal departments, viz., the dye house, the cleaning house, the finishing house, and the overhauling room.

MR. BECKINGSALE visited Aberdeen on the 28th ult., for the purpose of arranging the positions of lamp-posts for Brush arc lamps, sixteen of which are to be placed in Castle Street, part of Union Street, Market Street, and Guild Street. They will range from 60 to 90 yards apart, and will be placed at the same height as those in Dundee (about 20 feet). Three lamps are also to be placed in the public hall in the Municipal Buildings. The authorities of the town have entered into a contract with the Brush Electric Light and Power Company of Scotland for this installation. Mr. Beckingsale is the general manager and electrician of the company. We also learn that the temporary installation of the Brush system in Dundee, concerning which we made some remarks in our "Notes" columns last week, is now working very satisfactorily.

THE TRANSMISSION OF MOTIVE-POWER.—We read that MM. Piette and Krizik, the inventors of the well-known "Pilsen" arc electric lamp, have, at an agricultural gathering at Lundenburg, in Germany, been driving an ordinary threshing machine by electricity and illuminating at the same time the yard in which the machines were exhibited.

THE ANGLO-AMERICAN "BRUSH" CORPORATION.—At a meeting held on the 29th ult., it was resolved that a call of £3 per share be made on the £4 paid-up shares of the Corporation, to meet the cost of extension of works and machinery and manufacture of stock, the same to be payable in instalments of £1 each on the 1st January, the 1st February, and the 1st March, 1883.

ELECTRICAL EXHIBITION, ROYAL AQUARIUM.—We are informed that the opening of this exhibition is now post-

poned till the 21st December. The transept is set aside for various systems, including those of Henley, Gülcher, Siemens, Paterson, &c., while the courts on the ground-floor will be occupied by Latimer Clark and Co. (Hopkinson), Jablochkoff, Duplex, Edmundson & Co. (Swan), Dixon and Goulard, D'Humy, and perhaps Lane-Fox. The *annexe* will be the locality for the Thomson-Ferranti system, and for an interesting general collection, including eleven or twelve motors. The picture galleries, &c., will be lighted by the Edison Company and Messrs. Woodhouse and Rawson. The exhibition will also include telephones and electrical meters.

THE STEAMSHIP "SCOTIA."—The s.s. *Scotia* of the Telegraph Construction and Maintenance Company has left the Victoria Docks for the Thames Iron Works and Ship Building Company's Dry Dock, where she will be overhauled previous to her going up to the company's works off Greenwich. She will then ship the new cable which has been made there for the Eastern Extension Company, and which is to be laid between Suez and Aden.

EXTENSION OF THE FRENCH GOVERNMENT CABLES ON THE NORTH COAST OF AFRICA.—The s.s. *International*, Capt. W. F. Wardroper, arrived on Monday evening, the 27th inst., at her moorings off the Silvertown Telegraph Works, on her return from laying, for the French Government, cables along the coast of Tunis. These cables consist of four sections, namely, from Soussa to Sphax, from Sphax to Bordj-Djerib, on the west coast of the island of Djerba, from Bordj-Djerib to Gabes, and from Aghir, on the east coast of Djerba, to Zarzis, on the frontiers between Tunis and Tripolis. The *International* left the Thames on the 21st September last, and the expedition was in charge of Mr. Theophilus Smith, assisted by Messrs. H. Benest, J. Rymer-Jones, J. W. A. Knox, and others, whilst the French Government was represented during the making and laying of the cables by Mr. J. Rambaud, engineer in the French Telegraph Administration, assisted by Messrs. Schaeffer, Durregne, and de Nerville. Mr. Cheylus, Directeur-ingénieur des Télégraphes, who is the head of the French Telegraphs in Tunis, joined the ship at Soussa, to witness the laying operations. We gave in our issue of the 2nd September last some particulars as to the various landing-places of these cables.

THE TELEPHONE CABLE ACROSS THE TAY.—The Dundee Harbour Committee have come to the conclusion that the position of the National Telephone Company's cable across the Tay is objectionable, as it restricts the anchorage ground in the river. This fact is to be reported to the Board of Trade, and a proposal made to have the cable placed as near to the Post-office cables as possible.

THE METROPOLITAN DISTRICT RAILWAY COMPANY AND THE POSTMASTER-GENERAL, IN THE MATTER OF THE ELECTRIC TELEGRAPH ACTS.

(Before Mr. Justice Field and Mr. Justice Stephen.)

This was an application on the part of the Postmaster-General, under the Electric Telegraph Acts, 1868 and 1869, to compel the Metropolitan District Railway Company to allow access to their railway for the purposes of the electric telegraph communication now, under those Acts, vested in the Post-office. The affidavits on which the application was made stated that by those Acts the Postmaster-General had acquired the telegraphs, and among others had acquired the undertaking of every telegraph company with which the Metropolitan Railway Company had any agreement; that at the time the company were the owners of telegraphic apparatus which constituted a complete system of telegraphy in connection with the working of trains and the traffic of the company, and there was no post, wire, or other telegraphic apparatus belonging to any telegraphic company on the company's lines which was necessary for establishing such a system of telegraphy; that the telegraphic apparatus belonging to the company remained the absolute property of the company after the acquisition by the Postmaster-General of the undertakings, under the 9th section of the Act of 1868; and that he became entitled, at his cost, to call upon the company to erect and maintain additional wires; and that he became entitled to a perpetual right of way for his poles and wires over the whole of the system of the railway company; that the question of compensation had been referred to Sir Henry Keating, who, in 1879, awarded to the company the sum of £22,245, which had been paid; and that on the 5th of December, 1881, the Postmaster-General had sent to the general manager of the company a letter enclosing an order upon the company for the erection of a 14-wire cable between Gower Street and Portland Road stations, at the usual rate of £1 per wire per mile for cost of maintenance. The manager replied that the amount of payment must first be settled with the company. The Postmaster-General replied that the company were not entitled to anything above the sum already awarded and paid. This was disputed by the company, who alleged that the Postmaster-General had made payments to other companies for "way leaves" under similar circumstances, but which the Postmaster-General denied. Correspondence continued, resulting in a refusal on the part of the company, and this led to the present application.

The Attorney-General (with him Mr. R. S. Wright) now applied on the part of the Postmaster-General for a *mandamus* to the company to direct them to do and allow what he required. The learned Attorney-General stated the effect of the enactments and of the affidavits, and after hearing him,

The Court granted a rule *nisi*.

TIDINGS OF COMFORT AND JOY.—Some time ago a Reverend gentleman in Glasgow cheered electricians with the encouraging news that they were working out their own salvation as well as that of world at large. The *Bullionist* now comes forward to soothe the troubled breast of the shareholders of the Subsidiary Brush Companies as follows:—"With regard to what comfort holders of patents of the present various systems of electric lighting may take from these encouraging remarks (that certain companies are paying their own expenses), it must be borne in mind that the new invention is yet in its earliest stages, and that their patents may at any time be rendered valueless by the discovery of new and perfected apparatus. It is not an agreeable contingency to have to face, but it is none the less a fact. In all experience regarding the development of great commercial ideas, it has generally been the rule that the pioneers of a special industry have been financially losers. This is, however, an inevitable result of the continued progress of science and civilisation."

INSTITUTION OF CIVIL ENGINEERS OF IRELAND.—At the opening meeting of this institution on Wednesday, the 6th prox., a paper on "Magneto and Dynamo-electric Machines" will be read by Mr. Angelo Fahie, C.E., and will be illustrated by numerous diagrams and some interesting experiments. A number of incandescent electric lamps will be shown in action. In our next issue we hope to give some extracts from this paper.

THE LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY.—This company, having received the necessary licence from the Postmaster-General, are about to begin opening telephonic exchanges in this country. We have also received information to the effect that Mr. José D. Husbands has resigned his position as general manager to the company, so that he may be able to attend to private affairs.

SPECIAL MEETING.—A special meeting of the Mediterranean Telegraph Company is called for to-day, to consider an offer which has been made by the Eastern Telegraph Company to purchase the telegraph lines of the undertaking.

A NEW DEPARTURE.—Mr. Fawcett has nominated a lady as medical officer to the Telegraph Department, General Post-office, London, the reason assigned is that the fair sex is especially represented amongst the officials of that department. *The Lancet* condemns in vigorous language the step and calls upon Mr. Gladstone to overturn the nomination. The clerks, male and female, are said to have sent a petition to the Postmaster-General praying him to cancel the appointment.

WILLIAMS *v.* WESTERN UNION TELEGRAPH COMPANY. HATCH *v.* WESTERN UNION TELEGRAPH COMPANY.—From a New York source we gather, in reference to the above suits, that Mr. Sewell, of Sewell and Pierce, who was the counsel for Messrs. Hatch and Williams, said:—

It will be remembered that in February, 1880, a suit was begun by them to restrain the threatened consolidation. Mr. Gould was [illegible] ing a cable to Europe, and tried to get control of the [illegible] Western Union Telegraph Company. He was then pri[illegible] of the American Union Telegraph Company, and by me[illegible] rates and other operations he succeeded in depressir[illegible] [illegible] Western Union until he got it down to such a [illegible] it would pay him to purchase. About this time [illegible]

his interest in the Western Union and Mr. Gould suddenly proclaimed himself the owner of a majority of that stock. A plan was then formed to consolidate the Western Union, American Union, and Atlantic and Pacific, and to do this the capital stock of the Western Union was increased from 40,000,000 dols. to 80,000,000 dols. Of the increase 15,000,000 dols. were divided among the holders of the Western Union stock. The project was carried out, but Messrs. Williams and Hatch dissented therefrom. They brought suit and obtained an injunction from Judges Spier and Sedgwick, but on trial of the cause before Judge Truax he decided in favour of Mr. Gould and associates. From that decision Messrs. Williams and Hatch appealed, and the appeal was argued in May last before Judges Freedman, Arnoux, and Russell, who now have reversed the decision, and declare the whole scheme of consolidation illegal and void.

On the above subject the New York *Herald*, of the 9th inst., also has the following :—

Western Union was especially weak and sold down to 80. A good deal of the water which was sponged up at the time of the consolidation with the American Union and Atlantic and Pacific lines is beginning to be squeezed out. Not only have the courts decided against the iniquitous consolidation and the issue of some fifteen and a half millions of fictitious and paper certificates, but new enterprises are under way, or are being inaugurated, that promise to start up a formidable opposition. On land the Mutual Union Company is tapping the Western Union Company at all its best paying points, and under sea a new cable will shortly be laid at such cheap rates for construction that the present cables, even under the guarantee of Western Union, will find it difficult to earn a dollar in the shape of dividends. While Western Union is hampered ashore by competing lines, it is also being loaded down by its contract to pay an absurdly high rental upon the cable lines—three of which are moribund, and only one of which is in a condition of life and activity. What between stock water and ocean water Western Union stands a good chance of suffocation, and so most people thought to-day when they either sold out their holdings or went short of the stock, knowing that lower figures must inevitably ensue.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

YORKSHIRE BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to September 28th, was filed on October 5th. The nominal capital is £300,000, in £2 shares. 61,633 shares have been taken up and £2 per share called thereupon. The calls paid amount to £122,943 10s., leaving £322 10s. unpaid. Registered office, 326, Mansion House Chambers, 11, Queen Victoria Street.

BRUSH MIDLAND ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to June 30th, was filed on November 23rd. The nominal capital is £250,000, in £5 shares. Of the first issue of 125,000 shares, 25,000 have been taken up. 3,200 are fully paid, upon 800 shares £2 10s. has been called up, and a call of £1 10s. has been made upon the remaining 21,000. The calls paid amount to £31,450 and considered as paid to £18,000, leaving £50 unpaid. Registered office, 31, Lombard Street.

J. B. ROGERS' ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to November 7th, was filed on November 14th. The nominal capital is £510,000, divided into 102,000 shares of £5 each, of which 100,000 are preferred or A shares, and 2,000 deferred or B shares. 3,143 shares have been taken up, and £2 has been called upon the A shares. The total calls paid amount to £5,051, leaving £1,235 unpaid. Registered office, 47, Holborn Viaduct.

NEW PATENTS—1882.

5552. "Voltaic batteries." L. HARTMANN. Dated November 22.

5566. "Exhausting the bulbs of incandescent electric lamps or other articles." N. K. CHERRILL. Dated November 22.

5580. "Certain improvements in the manufacture of carbons, candles, electrodes, &c., for electric lighting and other purposes, and also for other articles, and in the machinery and mechanical arrangements relating thereto for making the same by compression, and in the regulation of the same whether made by hydraulic or other power." W. CUNLIFFE. Dated November 23.

5584. "An improved electric bell." W. R. LAKE. (Communicated by C. F. DE REDON.) Dated November 23.

5586. "Underground conductors for electric currents for lighting." R. GÜLCHER. Dated November 23.

5594. "Dynamo-electric machines." C. D. ABEL. (Communicated by B. Abdank-Abakanowicz and C. Roosevelt.) Dated November 24.

5601. "Secondary batteries." A. TRIBE. Dated November 24.

5625. "Improvements in telephonic apparatus, and in materials therefor." J. B. SPENCE and J. E. CHASTER. Dated November 27.

5631. "Dynamo-electric machines." C. A. MCEVOY and J. MATHIESON. Dated November 27.

5633. "Telephonic apparatus." H. H. LAKE. (Communicated by J. H. Rogers.) Dated November 27.

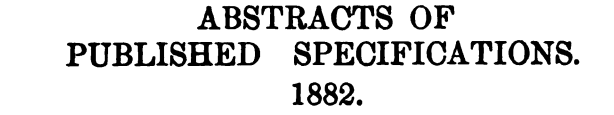
5644. "Secondary batteries or electric accumulators." J. LEA. Dated November 28.

5645. "Primary voltaic batteries." G. G. ANDRÉ. Dated November 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1787. "Dynamo - electric and electro - dynamic machines." B. H. ANTILL. Dated April 14. 2d. According to this invention electric currents are generated by the movement of coils of wire through magnetic fields without change of polarity, or by the movement of magnetic fields of constant polarity relatively to coils of wire. *(Void by reason of the patentee having neglected to file a specification in pursuance of the condition of the letters patent.)*

1822. "Electric lamps." A. S. CHURCH. (A communication from abroad by J. B. King, of America.) Dated April 17. Heretofore in electric arc lamps both solid and tubular carbons or electrodes have been used, but in either case the combustion has been more or less imperfect, and by reason of the ashes or unburned carbon the light has been flickering and unsteady. The objects of the present invention are to keep the carbons clean; to increase the steadiness and brilliancy of the light; to equalise and intensify the combustion of the carbons; and to cause the carbons to last longer than heretofore. In carrying the said invention into practice, the inventor combines, with a hollow carbon or electrode, a piece of moist sponge or similar substance, through which atmospheric air may pass to the arc, and he provides an electric conductor, passing through the carbon or electrode, all as hereinafter described. The figure is a central section of a carbon or electrode, having the sponge suitably attached thereto. A is the carbon or electrode having the central aperture or channel, B, extending longitudinally through it, and C, is a spiral wire within the same, extending the entire length of the said carbon or electrode. In the figure, D, is a tube or cap attached



to the base of the carbon, and containing a piece of sponge, E (or similar substance), which is covered by wire gauze, F. In the cap, D, is an aperture that allows air to enter beneath the sponge, whence it may pass through the sponge to the carbon. The lower end of the spiral wire, C, passes through the hole or aperture in the cap, D, to the outside thereof, and is connected with the source of electricity. In some cases, instead of forming the internal conductor of a spiral wire as shown, it is formed by electro-plating the inner wall of the carbon or electrode. The sponge is to be kept moist. Usually the lamp will be self-supplying in respect of moisture by the chemical union of the hydrogen and oxygen effected by combustion, or by the action of the electric current. The quantity of air passing through the carbon is regulated by the intensity of combustion, and the moist air has the effect of casting off the ashes. By means of the internal conductor terminating at the arc, the inventor is enabled to utilise the electric force more completely than has heretofore been practicable, and thereby to render the light steadier, and to equalise and intensify the combustion of the carbons or electrodes.

1830. "Mechanism for transporting goods and passengers by electricity." FLEEMING JENKIN. Dated April 17. 6d. Has for its object improvements in means and mechanism for conveying goods and passengers from place to place by the aid of electricity. The inventor employs for this purpose strained cables or conductors which serve both to suspend the load and to convey the electrical energy. Wheels are arranged to run along the cable or conductor and the loads hang below, suspended from the axles of the wheels. In the simplest arrangement at each post or support there is a break in the electrical continuity of the cable or conductor and the sections are insulated from each other and from the earth. The sections are, however, coupled together by movable coupling-pieces. An electrical current is maintained throughout the system by a dynamo-electric machine driven by a steam-engine, or in other convenient way. The loads are connected together in trains, and the length of a train is about that of a section of the cable or conductor. A train passing either of the movable coupling-pieces already referred to, moves it and throws it out of action and the current then passes by a conductor on the train itself. The current is conveyed through an electro-motor which drives the wheels and propels the train. The power provided is more than sufficient to maintain a maximum speed, and the train is

provided with a governor which, when the speed is sufficient, closes a shunt and allows the current to pass without traversing the coils of the electro-motor.

1850. "Negativing or destroying the effects of induced currents in telephonic lines." R. D. Smillie. Dated April 18. 2d. The invention consists of a pair, or other equal number of pairs, of coils surrounding a central core of iron or wire, applied at each end of a telephonic circuit, the said coils being insulated from each other and from the cores, and arranged so that the inducing currents pass into the coil which immediately surrounds the first core, and from that to the outermost coil of the series of coils surrounding the second core. From the outermost coil of the second core the currents pass back into a second or other intervening coil or coils of the first core, and thence to the line. In connection with this invention, a double line or metallic circuit is employed, and the effect is that the currents induced therein by adjacent telegraph or other telephonic line are brought to react upon each other in the said metallic circuit and are thereby negatived. (*Provisional only.*)

1851. "Insulated supports for the communicating wires of telephones." C. Curtoys. Dated April 18. 4d. Relates to improvements in the insulated supports which are used for carrying the wires of telephones, and has for its object to provide a support which can be readily and conveniently fixed in its carrier, and to which the wires may be more conveniently and readily connected than hitherto, the said supports being also lighter and cheaper in first cost than are such supports as at present constructed.

1853. "Transmitting and receiving apparatus for printing telegraphs." W. J. Burnside. Dated April 18. 8d. Has for its object improvements in transmitting and receiving apparatus for printing telegraphs. In the receiving instruments of type printing telegraphs, the inventor employs, as in the receiving instruments of other printing telegraphs, a type wheel, to which a step by step revolving motion is imparted, such step by step movements being controlled by a series of electrical pulsations alternately of opposite polarity, which are transmitted from the sending station. The pulsations cause a rapid to and fro vibration between electro-magnets of an armature mounted on an axis, which also carries escapement pallets acting with an escapement wheel on the axis of the type wheel. The axis of the type wheel may either be driven by a train of clockwork, or the revolving motion may be given to the escapement wheel by the to and fro movement of the pallets. In the above respects the apparatus possesses no novelty. The currents are made to pass not only through the coils of the above-mentioned electro-magnets, but also through the coils of another electro-magnet employed to actuate the impression or printing lever. The weight of the lever and armature tends to cause the armature to drop away from the magnet, a spring also tends to draw away the armature. So long as the alternate currents are passing through the coils of the electro-magnet, the armature is not drawn up to the magnet; but so soon as the reversals of the currents cease, and a current of either kind continues for a slightly longer time, the armature in connection with the printing or impression lever is drawn to its magnet, and the pad or platten carried by the lever strikes the paper against the type of the type wheel, which is then opposite to it. In order to be able to set the type wheel to zero the axis of the type wheel has a radial pin standing out from it. A lever arm is held by friction to one of the axes of the train of wheels by which the type wheel is driven. The revolving of the axis tends to carry the lever arm into the path of the radial pin on the axis of the type wheel and stop the type wheel. Each time that the impression lever is impelled towards the type wheel, a claw upon the lever turns the arm away from the type wheel to such a distance that the type wheel is free to make somewhat more than two complete revolutions before the detent can come into the path of the radial pin, so that the type wheel can always be brought to zero if allowed to turn for more than say two complete revolutions without printing.

1862. "Electrical railways or tramways." T. J. Handford. (A communication from abroad by T. A. Edison, of America.) Dated April 18. 8d. Relates to improved means and apparatus for operating or propelling railway or tramway carriages, cars, or vehicles by means of electricity, and to the construction of the carriages, cars, or vehicles, and the arrangements of circuit connections for motors, as well as for track-switches, turn-tables, and other appurtenances, and for the electrical generators. It is the object of one part of this invention to provide simple and efficient means for permitting the gradual retardation or slackening of the speed of a carriage or car for railways or tramways, or a train of such carriages, or cars operated by one or more electro-dynamic motors carried thereby, without depending upon the brakes for this purpose.

2452. "Incandescent electric lamps." J. Wetter. (A communication from abroad by L. Nothomb, of Brussels.) Dated May 24. 6d. Consists essentially in the nature of the carbon filament and of the surrounding atmosphere, in the mode of fixing and in the composition of a cement for connecting the wires to the carbon. The incandescing conductor is formed by animal parchment or cellulose carbonised in an atmosphere carburetted by any suitable means. The cellulose is thus impregnated with carbon. The carbon is fixed to two copper wires by means of a special cement composed of spongy platinum or iron and any organic matter, preferably molasses or sugar, which in carbonising produces a very hard and dense carbon. In order to insure a perfect contact the ...er wire is wound several times around the carbon and the con... ...n rendered more solid by cement. The short copper wires ...ate at the opposite end in two short platinum wires passing ... the glass globe, and terminating outside with two eyelets, by ... the lamp can be hooked to any suitable bracket. In order to ...e the resistance of the glass globe against the pressure of the ...al atmosphere the inventor balances the said pressure by filling ...side with a gas which has no effect on the combustion of the ... filament, ... , nitrogen or hydrogen.

2632. "Electric lamps." W. R. Lake. (A communication from abroad by J. J. Wood, of Brooklyn, New York.) Dated June 5. 6d. Relates to that class of lamps in which the regulating armature carries a vibrating train of wheels which is engaged at the leading pinion with a rack on the carbon-holder, and which has a terminal scape-wheel or detent which is brought up against a stop-tooth when the armature is attracted to separate the carbons, and is withdrawn from the stop when the armature is retracted to allow the top carbon to descend and the gear train to run down to feed the carbons.

2644. "Underground electrical conductors." Lionel Varicas. (A communication from abroad by G. Richardson, of Philadelphia, America.) Dated June 6. 10d. Relates to underground electrical conductors, conduits therefor, and ways and means of laying and insulating bare conductors as well as laying previously insulated conductors, and consists in incasing bare electrical conductors with pure hydraulic cement for the purpose of insulating them and protecting them from moisture and corrosion.

2744. "Dynamo-electric machines and electric motors." J. Imray. (A communication from abroad by J. J. McTighe and T. J. McTighe, both of America.) Dated June 10. 6d. Relates to the construction of dynamo-electric machines and electric motors, and is designed to improve the method of making and fitting the parts. It consists in improvements—firstly, in the construction of the armature or ring; secondly, in that of the commutator, and finally in the construction and disposition of the field magnet.

2885. "Electric machines." J. A. Berly. (A communication from abroad by F. V. Maquaire, of Paris.) Dated June 19. 6d. Relates to improvement in dynamo-electric and electro-dynamic machines.

3039. "Galvanic batteries." C. P. Nézeraux. Dated June 28. 6d. Has for its object the remedying of certain inconveniences and defects which exist in secondary batteries.

3330. "Electric lighting and power distributing systems." S. Pitt. (A communication from abroad by Eli T. Starr and W. J. Peyton, of America.) Dated July 13. 10d. Relates to certain improvements in distributing electricity as a source of power, and for lighting and other purposes.

3443. "Medical battery." W. R. Warren. (A communication from abroad by G. M. Hopkins, of America.) Dated July 20. 4d. Relates to the class of voltaic batteries employed for curative purposes, and consists of a case containing zinc and copper electrodes, separated by sheets of bibulous paper saturated with an exciting fluid, and a cover fitted to the case, and carrying two contact springs for making connection with the two electrodes, one spring touching the zinc, the other touching the copper, the two springs being clamped to the case cover by bolts passing through holes in the cover, and each provided with two milled nuts, between which the conducting wires or cords are clamped. The invention further consists in electrodes of sheet metal cut in circular form, and each provided with two slits parallel with each other, and located at diametrically opposite edges of the disc, the slits being adapted to receive a flexible band for binding the electrode to any part of the body, or to a sponge to be used for bathing.

3881. "Electric lamps and conductors therefor." F. R. Wells. (A communication from C. E. Scribner and W. R. Patterson, of America.) Dated August 15. 6d. Has for its object, improvements in regulating the feed of the carbons in electric arc lamps and in the insulation and construction of the electric conductors of the same. For the purpose of controlling the distance between the carbons of an arc lamp an electro-magnet, having its coils in the main circuit, is employed; it operates upon an armature wound with a coil by which the arc is shunted. The armature by connection with a lever, or otherwise, carries a clutch or clutches in which the upper carbon is held. Sometimes two clutches are employed; one in rising takes hold of the upper carbon and lifts it away from the lower carbon; and the other as the armature oscillates propels the upper carbon gradually downwards. The conductors leading from the dynamo-electric machine or other electric source to the lamp or lamps may be contained in a cable. The cable has a central conductor consisting of a cord of fine copper wire, thus surrounded and insulated by jute fibre. Copper wires laid over this form a second conductor on which again there is an insulating layer of jute, and over the jute there is cotton. The whole is contained in a double tube or casing of lead in which steel wires are embedded.

CITY NOTES, REPORTS, MEETINGS, &c.

BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND.

A general meeting of the above company was held in St. Michael's Chambers, George Yard, Lombard Street, on Tuesday, the 28th instant, the Earl of Crawford and Balcarres presiding. The convening notice having been read,

The Chairman said: Gentlemen, we have met to-day in order to receive a statement from the board as to certain proceedings which have taken place owing to the letter of Sir Charles Bright, and to consider what will be the effect of certain actions brought by some of the shareholders against the company. Perhaps it would not be wrong if I were to say a few words on the origin and history of the company. In 1881 the Anglo-American Brush Electric Company, desiring to extend their business in Scotland, entered into a certain contract to form a small company in Scotland to introduce their system. Later on they desired that Mr. Hope should form a larger

company in order to work the patents on a more extended basis. Mr. Hope duly formed it, calling it the Scottish Brush Company, and he then proceeded to lay the ground for the formation of the present company, of which we are members. When their shares were placed in the market the application for them was very remarkable, for our 20,000 shares we had applications for 373,281. The directors did all they could to make the allotment as just and fair as possible. They spent a large amount of labour on this very difficult and delicate work, and I think they did it conscientiously. The point that I now wish to call attention to is the question of the licences. These licences were handed over by the Anglo-American Brush Company on March 14th to the Scottish Company. The licence of the Brush patents, after rehearsing the considerations, passes on to say, "The Corporation do hereby grant unto the licensees full licence within Scotland, hereinafter called the district, but not elsewhere, to use and authorise others to use, but not to manufacture, dynamo-electric machines and lamps with the invention to which the letters patent refer." Further on in Section 3, "The Corporation will not use or authorise the use by others of dynamo-electric machines or supply others with any other dynamo-electric machines or lamps." This is the licence of the Brush patênts. I will now read the licence given with regard to the Lane-Fox patents. After rehearsing as before, it proceeds: "The Corporation do hereby grant unto the licensees full licence within Scotland, hereinafter called the district, but not elsewhere, to use and authorise others to use, but not to manufacture, electric lamps and other apparatus in connection therewith." Further, in Clause 3, "The Corporation will not use or authorise the use by others for the purpose of incandescent lighting or supply others with any such electric lamps for use within the same district." The terms are the same. There are two differences between the licence for the Lane-Fox patent and the Brush. The clauses of the Brush are nine in number. The clauses of the Lane-Fox are 11 in number. The Lane-Fox licence states that the licensees should to the best of their ability push the sale of the said lamps, and should they not push the sale, the licence should *ipso facto* become void. The 11th Clause is that in the event of the licensees finding it necessary to wind-up or go into liquidation either as a company or as individuals, the licence should lapse." That is the entire difference between these two licences. Both are in terms which may be considered exclusive licences. I do not at the present moment wish to go into the whole question. I can only say that the words of the licences were very carefully considered by the gentlemen who drew up our prospectus, in which they only followed those of other companies. In common with these they believed that by the licence granted for the Lane-Fox we had a power of supplying Lane-Fox lamps which nobody else had, consequently our prospectus was issued in all good faith. I thoroughly believe that what was said was correct. Then a short time since—I cannot recollect the date—a letter appeared in the ELECTRICAL REVIEW, signed by Sir Charles Bright, and disclosing to us all that there had been a licence granted to the British Electric Company previous to that which was granted to us, that to that licence there was a covenant as a separate deed which was signed by the British Electric Company, agreeing that they would not in any manner use the name of the Lane-Fox in connection with their business. Therefore the British Company are in possession of a patented method, but they are without the power of using the name of Lane-Fox before the public, and of showing in any way whatever that their position has anything to do with the Lane-Fox. They cannot sell the Lane-Fox as such in Scotland or anywhere else (hear, hear). When I saw this letter, I was rather surprised. I could not help asking myself a question: Why was this not said before? Why has the British Electric Company permitted this false statement that they say we have made to remain unnoticed? I have never tried to give an answer to these questions.

The next question we have to bring before you is to inform you that certain shareholders of the company have taken action against the company, requesting the return of their capital, the amount of money laid out by them in purchasing their shares. Certain questions are raised by the litigation which I may summarise to you shortly. First of all, the question will arise: Is the statement in the prospectus a misstatement of fact? The shareholders will doubtless say, "Yes," as the licence is shown in the prospectus to be exclusive, and as it is shown that there is another licence in existence. For the company we may say that the prospectus is not a misstatement, as the licence is in terms exclusive, and although the British Electric Company have a licence for the process, it cannot sell the Lane-Fox lamp under such a name. It can sell an article consisting of a piece of glass from which the air is exhausted, in which there is a filament of carbon of a certain shape—of the general form which all incandescent lamps assume—the Lane-Fox, the Swan, the Edison—in which the light is produced by the filament becoming white hot under the electric current. The British Electric have a licence for the process, but they cannot sell the result as a Lane-Fox. Assuming, however, that what we have placed before you in the prospectus is a misstatement, the question will arise, Is it a material misstatement, and one which would entitle a shareholder to set aside the prospectus? To this, as a matter of fact, it may be replied that the Lane-Fox patents are no longer of very great value. I do not like to say myself, of my own opinion, whether it is a material misstatement or not. Of course it would be open for a shareholder to say before the judge that at the date of his application for shares it was the statement as to the Lane-Fox lamp which induced him primarily to subscribe, though the Lane-Fox is worth nothing now. If this litigation proceeds, there will be certain effects possible, certain effects probable, certain effects certain to this company. We have to do with an unknown quantity when we come to litigation. We are in presence of the great infinite—(laughter)—and we are unable to say how the carriage of justice will proceed. Very often it appears perfectly certain to both sides that they are in the right, and yet the judge contrives to say that one is in the wrong. The actions may be successful: that is not for us to foretell. There is always this element of uncertainty—but there is a point which is absolutely certain—that this litigation must involve the company in serious expenses in defending itself. It must also hinder us from carrying on the work of the company, because it is impossible to proceed to any extent with a liability hanging over us which cannot be estimated for a considerable period of time. Another point: The Lane-Fox being, as I remarked before, of small commercial value now, the question might be put in this way:—You state that you have a valuable article. But it is valuable no longer. The question would then be, whether, as the shares of the company are not now worth what they were at first, a shareholder could, therefore, demand the return of his money? Assume that the actions are upheld against the company. In all probability we should not recover from the blow; we should have to go into liquidation, and what we consider a really flourishing business would be thrown away (hear, hear). There is, even as it is, the question of litigation which everybody is glad to be out of. What I consider to be as harmful to the company as loss of money by litigation, is the loss of time, and of the opportunity of pushing our system. How can we go over Scotland and take contracts, how could we lay out money while in this position? If the shareholders to-day, after having heard what has been said, should give us the means of feeling that it is our duty, and in their interests to carry on the business of the company, we would feel far more pleasure, knowing that we had the confidence of the shareholders. Although our directors do their best at present, they will then endeavour to do their double best (hear, hear). I forgot to mention that perhaps some of the shareholders would like to know something of what has been done in Scotland. If they will permit me I will call upon Mr. Dickson, who has given very great time, deep consideration, and anxious thought to the matter, as our manager (hear, hear).

Mr. Dickson said that doubtless all present would like to know what they had got for their money, and what they were likely to get in the future, in the shape of purchasers, as regarded the concessions which they had. At the time the company was formed they all thought it would be like the parent Brush Company for Scotland, and when it had gone on a little, and when confidence had been restored, that they might stand in the position of the parent Brush with regard to those thriving industries, particularly in the South and West of Scotland; but when that had been done they put themselves to it and did the best they could. Irrespective of the incandescent light, the great *pièce de résistance* consisted of the Anglo-American dynamo machine, than which a better had not been found for the purposes for which they were using it (hear, hear). The buyer of a share in the company, unless he bought his shares simply to speculate on them, should know what he was buying, and therefore all of them would doubtless know something of the Brush dynamo. He might say that in America at least 95 per cent. of the lights there were wrought on the Brush system for arc lighting. There was nothing in the whole of the researches, and for six months he had been looking as carefully in the matter as he could, that would at all touch that dynamo. No dynamo for arc lighting, and for such purposes as that company contemplates, the lighting of large towns and streets, can at all compare with this machine. With a high tension it could work miles of current. In proceeding with his work he did not go, as it were, broadcast over Scotland. He selected four of the principal towns—the foremost in Scotland—Edinburgh, Glasgow, Dundee, and Aberdeen. He was acquainted generally with the provosts and bailies; and though it was rather up-hill work convincing men of the advantages of the electric light who were, at the same time, gas commissioners, there was one fact looming in front of them which helped him, and that was Mr. Chamberlain and his Act of Parliament. They were forced to do something, and the Brush Company, being in the field, naturally got the orders. They must take the bill and do what they could with it in the public interest. And, therefore, when he put all the facts before them that they were prepared to light their public streets, and that they were not fighting against them, but for them, that their plans, when laid before the Board of Trade to meet their approval, the Darwinian doctrine of the survival of the fittest came in. In many cases he succeeded in obtaining a position for this company. In order to do this—that was, to light the principal streets of the principal towns, they required a large horse-power. It was useless to talk of engines such as the Roby, the Marshall, the Fowler, of 10 or 20 horse-power; they must go bang at it, with a good 500 horse-power, till they had a large supply almost as cheaply as a small one, and could work a large circuit as inexpensively as a short one. Under these conditions they could run gas a pretty sharp turn for it. No other dynamo could run such a current from one single centre, and therefore none could do it so cheaply. Take the case of Greenock. There there were five centres, and that entailed the running of five sets of machinery, different staffs, and all the multitude of things that was comprehended in more than one system. The Brush dynamo did away with all that. In Edinburgh they wrought all their system from one place. They ran a wire alongside the railway, and had their head-quarters some distance out. So also in the case of Dundee, Aberdeen, and Glasgow. He had gone into the matter as economically as possible, and the installations were erected as cheaply as could be done. In Dundee lights were now running that gave the utmost satisfaction to the people. The illumination was so good that the gas was being put out in the shop windows. They were, as he had said, working as cheaply as possible, but he did not believe in doing work for nothing. Some agents could do small orders for a trifle less than their larger dynamos could be profitably worked for. But this state of things would alter. Dynamos were becoming cheaper. At the time when they were in contract for Edinburgh a Brush dynamo cost £750, they could now buy one for £520, and by-and-bye it would be cheaper still. They had reduced their prices 40 per cent., and they were advancing by strides in electrical knowledge; the knowledge of six months ago was the ignorance of to-day. All their capital was intact, and was

earning what would keep the company out of trouble. After these remarks he thought that nothing could be more suicidal and idiotic than to stop their business. They were working as hard as brains could do, and watching progress in the electrical world. Any of them would see what was coming about in the shape of accumulators The lights they had running were in the very best positions in the respective towns. They had not gone away outside, but had taken the very centre and kernel of the cities they were at work in. He believed they had advantages which would tell enormously in their favour.

A Shareholder asked whether they were making any profit out of the corporations that they had selected in Scotland?

Mr. Dickson could only say that they were not doing their work at any loss.

Ashley Ponsonby, Esq. (on the board), said that this letter of Sir Charles Bright had done them a great deal of harm, and put them out of a great deal of work. What they wanted was a decided opinion, one way or the other, whether the shareholders would endorse what they had done, or were satisfied with what they were doing. The action of Sir Charles Bright had paralysed them. Yet they, as men of business, believed that the whole of that letter was simply smoke—it was nonsense. The Lane-Fox licence might not be theirs as a technicality, but as far as the future dividend was concerned, that letter did not interfere with them the snap of a finger. The Brush system of arc lighting was almost perfect—of course improvements would occur—but it was as good as or better than any other system—and far cheaper. The Swan, *e.g.*, was a luxury, and might be employed in shops, and churches, and theatres—but the big dividends came from lighting streets, and factories, and large works. Should improvements be made which would bring incandescent lighting into great prominence; they had the light of the Lane-Fox to make what use of it they liked. Then in the future they could not only get coal cheaper in a good many of their districts, but they could work up water power, which would be doubtless utilised to a far greater extent than now. He had perfect confidence in the future of the company if they put their foot down at once, and said that they would not stand this opposition.

Mr. Cunningham said, with regard to the Lane-Fox lamp, he did not understand whether it was the Anglo-American or the Scottish Brush that had granted the concession to this company. Another thing he would like to know: They had heard that an exclusive right had been granted to use the Lane-Fox; but he had not yet heard whether the company proposed to take any steps to hold that company that had granted the concession responsible or liable in some way or other for damages. He did not quite see the point of the fact, that the British Electric Light Company had a right to use the lamp, though not the name; but perhaps that was not very material. Did the directors intend to lay any claim against the parties who had deceived them in the matter? It was of no importance that the Lane-Fox was of no great utility, they had bought the thing, and they were entitled to have it. The same thing might perhaps be said of the Brush if it should happen to be superseded. The question was, their right, and not its value.

A Shareholder asked if the Hammond Company were competing with them to light up some towns in Scotland?

The Chairman said that they had an exclusive right to the Brush in Scotland. With regard to Mr. Cunningham's question, the term "exclusive licence" was used, though in other cases the word was full. The licence had been granted from the Anglo-American Brush Corporation to the Scottish Brush, that was the company formed by Mr. Hope, and from the latter they had sprung.

The Solicitor to the company said that in legal phraseology an exclusive licence was a licence in which the granter covenants in regard to something that was granted to nobody else. As a matter of fact, when the Lane-Fox licence was given there was another licence then in existence. It was not convenient to discuss whether there was liability on the part of the Anglo-American Brush, or the Scottish Brush; but he would say that this company had made an intimation to the Scottish Brush, that they had certain claims to make upon them with respect to that (hear, hear).

The Chairman said that boards of directors often made arrangements with individual shareholders to move resolutions. He had not done so, but he would be glad if some gentleman would move the resolution which he would read. It ran thus:—"That this meeting, having heard the statements of the chairman, expresses confidence in the board of directors, and requests them to carry on the business of the company; and to oppose all hostile actions brought by shareholders against the company."

Mr. Dalrymple moved the resolution.

Mr. Delmege, in seconding the motion, asked what would be its effect. If the company defended the action, who would have to pay? He would ask why they could not have a test action brought? Could not the seven or eight companies who were threatened with actions combine and bring forward one representative action?

The Solicitor said that the actions brought would presumably be for the return of sharemoney on the ground of misstatement as to the Lane-Fox, but the claim had not yet been formulated. It would, doubtless, be beneficial if a test case could be brought.

A Shareholder said that they had every confidence in the directors, and in Mr. Dickson, who would work anything he was engaged in to the bottom. As to the superiority of the Brush system, he had recently heard from a friend, at present in America, who was interested largely in electric light enterprise, and he said that the Brush there was as 50 to 1 when compared with all other systems (hear, hear). The Yankee was a pretty 'cute fellow, and would not go so largely into the Brush unless there was something in it. He had perfect confidence in the Brush and in their board. As for this litigation, it was a foolish step in the shareholders who began it. He had heard, however, that one company had already obtained on account of the Lane-Fox blunder the sum of £21,000 (no, no. A director: Not a penny!). If our company could get back anything they should too.

Mr. Bullivant would gladly support the resolution just moved and seconded. The question for them as business men was, should the business be carried on, or should they let themselves be bamboozled by a parcel of pettifogging lawyers who were sending their circulars about endeavouring to prejudice the minds of shareholders at an undertaking which they believed would be a most lucrative one, for the sake of getting their paltry fees for winding the company up? should they let their money go into these fellows' pockets? They had got a business which nobody could doubt would be most lucrative, as the electric light would be the light of the future. They had a system with which no other could be compared. The lights of the system in London were all run by a single machine, which they could put in a corner of the room—something like six feet by three—two miles of wire being in the whole circuit, and it had run for 18 months without costing the company more than £5 for repairs. Other systems would have an initial expense that would swamp them if they were to attempt to light the Brush circuit. He had much pleasure in supporting the resolution.

The motion was then put to the meeting and unanimously carried.

On the motion of Mr. Pastow a vote of thanks to the chairman was passed by acclamation, and the proceedings terminated.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—We learn that this company has received information of the interruption of the cable between Jamaica and Porto Rico, cutting off from telegraphic communication all the company's stations in the West Indies, except Jamaica. The company's ships have been ordered to repair the cable.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations Nov. 29.	Business Done
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9¾-10¼	[illegible]
		Do. Do.	10	19 - 22	21½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1 - 1½	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½ - 1	
25,000	5	Great Western Electric Light & Power Co.	2½	¾ - 1¼	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	4¾ - 5¼	[illegible]
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1 - 1	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½ - ¾	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1¼ - 1½	
..	..	South African Brush Electric Light & Power Co.	2½	¾ - 1¼	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2½	[illegible]
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	47½ - 48½	
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	77 - 78	77 [illegible]
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	17 - 18	
130,000	10	Brazilian Submarine, Limited	10	11½ - 11¾	11[illegible]
16,000	10	Cuba, Limited	10	9½ - 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	7 - 7½	7[illegible]
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
65,000	20	Direct United States Cable, Limited, 1877	20	11 - 11½	11[illegible]
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 - 103	[illegible]
380,000	10	Eastern, Limited	10	10¼-10¾	[illegible]
70,000	10	Do. 6 per cent. Preference	10	12¾ - 13¼	13[illegible]
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 - 103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 - 104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 - 106	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½ - 12½	12[illegible]
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	108 - 111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	105 - 108	
140,000	100	Do. do. registered, repayable 1900	100	105 - 108	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 - 104	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 - 105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 - 105	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¼ - 6¾	6[illegible]
163,209	10	Do. 6 per cent. Preference	10	12¾-13¼	[illegible]
125,000	10	Great Northern	10	12¾ - 13¼	13[illegible]
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 - 103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28½ - 29½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 - 103	
17,000	25	Indo-European, Limited	25	30 - 31	
38,148	10	London Platino-Brazilian, Limited	10	4 - 4½	
12,000	10	Mediterranean Extension, Limited	10	1½ - 2	
8,200	10	Do. 8 per cent. Preference	10	6 - 6	
9,000	8	Reuter's, Limited	8	12½ - 13	
280,000	Stk.	Submarine	100	245 - 255	
58,225	1	Do. Scrip	1	2¼ - 2½	2[illegible]
4,200	Cert.	Submarine Cables Trust	100	105 - 107	[illegible]
37,350	12	Telegraph Construction and Maintenance	12	32 - 33	32[illegible]
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 - 105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½ - 1¾	1[illegible]
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7½ - 7¾	7[illegible]
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 - 107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	95 - 98	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	121 - 126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 - 103	
88,321	10	West India and Panama, Limited	10	1½ - 1¾	1[illegible]
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5¾ - 6¼	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	[illegible]
300,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	[illegible]	½ - [illegible]	[illegible]
100,000	5	United Telephone Co.	[illegible]	[illegible]	[illegible]

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 263.

THE "FERRANTI" DYNAMO-ELECTRIC MACHINE.

Since writing our description of the "Ferranti" machine, which appeared in our last issue, we have been favoured by Mr. F. C. Phillips, the managing electrician of the Hammond Electric Light Company, with a short table of data giving the conditions under which the machine was working on the occasion of the public exhibition. It will be seen that but little difference exists between these figures and those we gave in our former article, and that the doubts we then expressed as to the correctness of the data given will apply with equal force to the table so kindly sent to us by Mr. Phillips, which is as follows :—

Current in main circuit	156 ampères
,, ,, each lamp	1·3 ,,
Resistance of armature	·0265 ohms
,, ,, external circuit	·7735·
Total ,, ,, armature circuit	·8
E. M. F. total...	125 volts
,, for each lamp	41 ,,
Resistance of field magnets	2·5 ohms
,, ,, exciting machine	·5 ,,
,, ,, ,, circuit	3 ,,
Current in exciting circuit	22·5 ampères.

As we mentioned last week the indicated horse-power of the steam-engine when driving the machine to produce the necessary current for 300 Swan lamps of 20(?) candle-power each was 25·5. In a pamphlet which was circulated on the evening in question and descriptive of the system, the horse-power was stated to be *under* 26, and labelled on the walls it was given as 27. We will take as an approximate average 26 indicated horse-power. Whatever may be the candle-power of a lamp when a current of 1·3 ampères is passing through it, and a difference of potential of 41 volts exists between its terminals, each lamp will absorb ·0714 of an electrical horse-power, and therefore 14 such lamps may be obtained per electrical horse-power. 320 lamps of this kind could then be sustained at a certain luminosity by the consumption of 23 electrical horse-power. To produce such a result, however, it must not be forgotten that every one of the 320 lamps must be identical one with the other.

We have calculated, of course, on the basis of a single amp, and we will now consider the figures given by Mr. Phillips in a somewhat wider sense. The calculated resistance of each lamp of the type given above and under those conditions is 31·5 ohms, and three in series would, therefore, amount to 94·5 ohms. If we take the average difference of potential between the terminals of each set of lamps as 23 volts, so as to allow for any slight loss of potential by eason of the distance of the lamps from the terminals of he machine, or the resistance of the conductor, we get hrough each branch a current of 1·3 ampères. We also find rom the table that calculation gives about 160 ampères as the ot[illegible] current, but according to our reckoning the external how [illegible]e—leaving the main conductors out of the question fectly [illegible] judge cont[illegible] say, ·9 of an ohm, and not ·7735 as given. From this we find that the current amounts only to 140 ampères, and we venture to say that were the resistance of the external circuit properly measured, it would come out considerably above one ohm when one takes into account the number of connections made from lamp to lamp and between the conductors, some of which may not be perfect.

According to Mr. Phillips' table we obtain from the total electromotive force and ampères combined, an expenditure of over 26 electrical horse-power, but with our modified figures we cannot arrive at more than 23, whether by calculating on the basis of a single lamp or from the calculated external resistance of all the lamps. If, however, we could measure this external resistance, we should doubtless find the electrical horse-power still further reduced. Another point has yet to be considered. The engineer-in-charge of the Ferranti installation, Mr. Logan, informed us that the engine when driving the countershafting and the machines with *open circuits* indicated *about* 7 horse-power. From this it will be obvious that the amount of engine-power taken up in *producing* the current for the 320 Swan lamps would be considerably *lower* than the electrical horse-power quoted, were the figures for obtaining the latter result to be depended upon. We should imagine that no tests of anything approaching an accurate nature had been taken from the "Ferranti" machine—the fact of its being an alternating current system would not of course tend to make such tests of an easier character—and it would appear that its presumed efficiency has been simply calculated from the known data of a Swan lamp absorbing a certain current strength and at a stated candle-power. It will be well remembered by our readers that Mr. Gordon, in calculating the efficiency of his machine, *assumed* that each of his 1,300 lamps was absorbing 1-10th of an electrical horse-power and giving each a 20 candle-power light, when, as a matter of fact, some of the lamps were not alight and others were glowing with a luminosity of 5 or 6 candles. We do not expect the "Ferranti" machine to give but little, if any, greater result per horse-power expended upon it than machines of the Edison, Gramme, Siemens', &c., type, although the relation of its armature resistance to the external resistance is remarkable; but it possesses the great merit of simplicity, and therefore it can compete on very favourable terms, as regards cost of construction, with any machine with which we are acquainted. We may add that the favourable opinion we have already expressed upon the "Ferranti" system is in no way lessened by the slight analysis we have given of the supposed data of the machine, our sole endeavour now, and last week, being to show those responsible for its introduction how important it is to give figures the accuracy of which cannot be challenged, or to leave electricians to form their own estimate of the true worth of the invention.

Electroliers for the Electric Light.—On Wednesday evening we paid a hurried visit to the works of Messrs. Verity and Sons, of King Street, Covent Garden, the well-known artificers in ornamental brasswork. The firm also acts as agent for the Edison system of Electric Lighting, and on the evening in question the members of the Board of Trade representing the Strand district were present to examine the system, which was explained by Dr. Fleming, Electrician to the Edison Electric Light Company. A 60-light (nominal) dynamo-electric machine was keeping in operation 75 lamps. Next week we hope to do justice to the exquisite display of electroliers manufactured by Messrs. Verity & Sons, by far the most complete and extensive we have yet seen.

THE ROYAL SOCIETY.

ON Thursday, the 30th ult., the president of the society, William Spottiswoode, Esq., D.C.L., LL.D., delivered his address at the anniversary meeting. We reprint those portions which we think will be of special interest to our readers, and refer briefly to some matters which are not connected with the electrical profession.

Mr. Spottiswoode commenced his address by alluding to the deaths of Darwin, Balfour, Sir Wyville Thomson, and others less known to fame, and after reference to the society's general arrangements, and a comparison of the number of papers received during the years 1873—1882, went on to say:—

Among the papers of this year, I may notice the elaborate research by Dr. Debus on "The Chemical Theory of Gunpowder," forming the Bakerian lecture; the careful and long-continued investigations by Professors Liveing and Dewar on the spectra of water, and of carbon, and of mixed vapours.

Nor must I omit mention of Dr. C. W. Siemens' bold and original theory of the conservation of solar energy, which has already given rise to so much discussion. It will be sufficient for me here to say that upon the questions therein raised the last word has been by no means said; and that, whether the theory be ultimately established, or whether, like a phœnix, it shall hereafter give rise to some other outcome from its own ashes, it will ever be remembered as having set many active minds at work, and will always have a place in the history of solar physics. . . . .

A most important change in the relations between the society and the Government in respect of State aid to science has been made this year. It will be in the recollection of the Fellows that an experiment was made for a period of five years, during which the sum of £4,000 was annually voted to the Science and Art Department, to be distributed at the recommendation of the Government Fund Committee of the Royal Society. That experimental period terminated, as then mentioned in my address, last year. The grant to the Science and Art Department has been discontinued, and in place of it an addition of £3,000 per annum has been made to the Government grant, making £4,000 in all. In concluding this arrangement the following stipulations were agreed to. The increased grant is to be administered by a committee identical with the late Government Fund Committee; a portion may be devoted to personal grants, subject, however, to special recommendations to the Treasury; and, lastly, unexpended balances may be carried forward from year to year, as has hitherto been the case with the old Government grant only. To the stipulation that the increased fund should be administered by the more extended committee the society felt that no reasonable objection could be offered, because upon it the President and Council are represented in full, and the *ex officio* members are, in the majority of cases, Fellows of the society. The object of the second stipulation was, so far as the society is concerned, to secure at the outset for the personal grants the consent and support of the Treasury, and thereby to preclude the chance of objection being subsequently taken to any of our proposals under this head. The President and Council, however, recognising the importance of great caution in respect of personal grants, have of their own motion appointed a special sub-committee (in addition to the three previously existing), to which all personal applications recommended by any of the other sub-committees are specially referred, and without whose recommendation none can come before the general committee. To the third mentioned point, viz., the power of retaining unexpended balances, the President and Council attach great value, because that power may enable the committee to devote more of its funds than heretofore to some of the larger undertakings in scientific inquiry, leaving more of the smaller grants to the special funds already in existence in the hands of the Royal and other societies. The meetings of this committee will probably take place twice a year, in May and November. In the present year it will not be possible to hold the second meeting before December, but there will be advantages in holding it hereafter in November, as the entire annual grants will then be made by the same committee and under the sanction of the same President and Council. In concluding these few remarks on the new arrangements, I cannot refrain from expressing my sense of the obligation under which the society and science at large are laid by the sympathetic and intelligent attention bestowed upon the subject by the then Financial Secretary of the Treasury, the late Lord Frederick Cavendish.

Among other subjects referred to the Royal Society by Public Departments I may mention a request from the Board of Trade for advice upon the question of improving the existing means at the Standard Office for the purpose of comparisons. At the request of the President and Council, Sir George Airy, Colonel A. Ross Clarke, and Professor Stokes acted as a Committee and drew up a very careful report, the value of which was fully recognised by the Board of Trade. The report suggested certain improvements in the present arrangements; but, having reference to the duties of the Standard Office as defined by Act of Parliament, it was not considered necessary to insist upon extreme scientific accuracy, such, *e.g.*, as that attained by Colonel Clarke himself in his "Comparison of Standards" made at the Ordnance Survey Office at Southampton in 1866.

The arrangements for the observation of the Transit of Venus have been steadily progressing. The parties have now all started for their stations, after their period of training under the superintendence of Mr. Stone at Oxford. An adequate supply of instruments has been secured at moderate cost, and all the accessory parts have been provided by the indefatigable care and forethought of our astronomer.

The English expeditions for the observation of the approaching Transit of Venus are organised as follows:—

ACCELERATED INGRESS.

Madagascar Observers.—Rev. S. J. Perry.
Rev. W. Sidgreaves.
Mr. Carlisle.

Cape Observatory Observers.—Mr. Gill and staff.

Aberdeen Road Observers.—Mr. Finlay, First Assistant of the Cape Observatory.
Mr. Pett, Third Assistant of the Cape Observatory.

Montagu Road Observers.—Mr. A. Marth.
Mr. C. M. Stevens.

RETARDED INGRESS.

Bermuda Observers.—Mr. J. Plummer.
Lieut. Neate, R.N.
Capt. Washington, R.E.

Jamaica Observers.—Dr. Copeland.
Capt. Mackinlay, R.A.
Mr. Maxwell Hall.

Barbadoes Observers.—Mr. C. G. Talmage.
Lieut. Thomson, R.A.

Besides the observers at these stations, the Canadian Government has arranged to place three 6-in. and some smaller telescopes in the field. Lieut. Gordon of Toronto was sent by the Canadian Government to England to make himself master of the proposed arrangements, and to secure the necessary instrumental equipment.

ACCELERATED EGRESS.

The stations for Retarded Ingress are also available for Accelerated Egress.

RETARDED EGRESS.

Brisbane Observers.—Capt. W. G. Morris, R.E.
Lieut. H. Darwin, R.E.
Mr. Peek.

New Zealand Observers.—Lieut.-Col. Tupman, R.M.A.
Lieut. Coke, R.N.

Besides these observers sent specially from England, the observatories at Melbourne and Sydney are most favourably situated for observing the egress. The directors of these observatories, Mr. Ellery and Mr. Russell, have promised their co-operation, and their Governments have placed funds at their disposal to cover any necessary expenses.

Unless unfavourable weather should prevent the transit being seen at some of the stations, we may expect some nine or ten pairs of corresponding observations, both at ingress and egress, from the British expeditions alone. These observations are certain to be largely supplemented by those made by the observers of other nations; and it is hoped, from the close agreement between the instructions issued to the different observers, that the whole may ultimately be available for combination in one general discussion.

The American astronomers, encouraged by the partial success which attended the plan they adopted in 1874, are relying chiefly upon the photographic method; they have sent expeditions to South America and the Cape of Good Hope.

Austria does not take any active part in observing the transit.

France sends out eight well equipped expeditions, full particulars of which have been published in the *Comptes Rendus* for October 2nd.

From Holland no special expedition will be sent out, but Lieut. Heyming, of the Dutch Navy, will observe the transit in the West Indies, probably at Curaçoa.

Italy will confine its operations to observatories in that country.

Russia, also, has decided to send out no expeditions of its own, but it has aided the efforts of other countries by lending a 6·5 in. refractor to the Danish Government, and has placed two excellent 4·3 in. heliometers in the hands of the French astronomers, MM. Tisserand and Perrotin. The considerations which led the Russian Government to this conclusion have been explained in the following paragraphs of a letter from Mr. Struve to myself:—

"Experience since 1874 has sufficiently proved that there is no prospect whatever, even with combined international efforts, of obtaining by the present transit a geometrical determination of the parallax of the sun, which would not soon be surpassed in accuracy by other recent methods (for example, that suggested by Mr. G— methods which are capable of being repeatedly employed, and that without any costly expeditions.

"Further, although it must be admitted that so rare an opportunity of studying the atmosphere of the planet ought not to be neglected, yet it seems certain that so many and such excellent ones will be obtained through the agency of the United States, as well as by other countries having well-provided observatories in the southern hemisphere, as well as by other seafaring nations." Under these circumstances Russia has not considered it incumbent on itself to organise any observing parties.

Spain has sent two parties of naval officers, well equipped with 6-inch equatoreals and other instruments, to the Havana and Porto Rico. . . . . .

The subject of the Circumpolar Observations mentioned in my address of last year, was since that time brought more formally before our Government by that of Russia. At the request of the Treasury the President and Council, after consultation with the Meteorological Office, advised as follows:—

"The object of the undertaking is to throw light on [illegible]

of the great inaccessible region surrounding the pole on the meteorology and magnetism of the earth. With this view it is proposed to take simultaneous observations at a chain of circumpolar stations for a full year at least.

"A chain of not less than eight stations will be occupied independently of any co-operation by this country. This chain, however, leaves a gap of 90° in longitude in the northern part of America, the centre of which would be advantageously occupied by a station in the Dominion of Canada. The value of the results will be greatly enhanced by the addition of this link to the chain. Independently of this, such a station would be of great value as being of a continental character, in contrast with the other stations, which are in close proximity to the coast. By choosing for the station one of the forts of the Hudson's Bay Company, no great outlay need be involved in its occupation."

The point first proposed was Fort Good Hope, near the mouth of the Mackenzie River; but it was found too late to erect the necessary huts and to transport the party and its provisions there during the present season. Fort Simpson, on the same river, was next suggested. Guided by considerations of facilities of access and sustentation, the committee came to the conclusion that either Fort Rae or Fort Providence, on Great Slave Lake, is to be preferred to Fort Simpson, with which the former forts nearly agree in latitude; and accordingly the President and Council recommended one of these.

"In framing an estimate, it was thought well to assume that the expedition might last a year and eight months, so as to allow a sufficient margin for travelling to and from the station, and for possible detention in waiting for the Hudson's Bay Company's brigade. It is calculated that the cost might be safely estimated at £3,000, which would include salaries of one officer and three men; journey of the party from England and back, including reasonable baggage, rations, allowances, and all other expenses."

To this communication the following reply was received:—

"My Lords have to thank you, and the Committee whom the Council appointed to advise them in the matter, for the valuable information contained in Dr. Michael Foster's letter of the 16th ultimo. Acting upon that information and upon the advice of the Royal Society, Her Majesty's Government have decided that this is an object on which public money may properly be employed, and they are prepared to ask Parliament to provide a total sum not exceeding £2,500 for the purpose. My Lords understand that there is good reason to hope that the balance required to make up the total estimated cost of £3,000 will be forthcoming from other sources.

"I am to ask whether the Royal Society would be so good as to take charge of the Expedition under similar conditions to those under which the Transit of Venus Expedition is being conducted; accounts of the expenditure chargeable to the Parliamentary grant being rendered to this Department. The choice of stations, the appointment of observers, and the methods of procedure would be left entirely to the society, subject to the condition that the total amount chargeable on public funds does not exceed £2,500. My Lords understand that it is expected that not more than £1,500 of this amount would come in course of payment during the present year, and they will present estimates to Parliament for £1,500 and £1,000 at the proper times."

The Canadian Government has since promised a contribution of 4,000 dollars towards the expenses of the expedition.

A committee, consisting of the President, Dr. Rae, Sir George Richards, Mr. R. H. Scott, and Professor Stokes, was accordingly appointed to superintend the expedition, which, comprising Captain H. P. Dawson, R.A., in command, Serjeants J. English, and F. Cookesley as observers, and W. Wedenby, as artificer, left England on May 11th, for Quebec, was heard of at Fort Carlton on 27th June, and was about to proceed the next day for Green Lake, on the way to Portage La Loche. It was still not quite certain whether it might not be necessary to push on to Fort Simpson, on account of insufficient accommodation, as well as lack of time and materials for building at Fort Rae.

Two parts of "Mittheilungen der Internationalen Polar Commission" have been published, containing full particulars and instructions relating to the whole circumpolar scheme. . . . . .

(To be continued.)

ON THE INFLUENCE OF TIME ON THE CHANGE IN THE RESISTANCE OF THE CARBON DISC OF EDISON'S TASIMETER.

By T. C. MENDENHALL, Columbus, O.

ABOUT five years ago Edison announced the discovery of the remarkable property possessed by carbon when prepared in a special manner, in virtue of which its electrical resistance was greatly lessened by subjecting it to an increase of pressure. Among the numerous interesting applications of this discovery which were quickly made, none was more promising or more interesting than the tasimeter devised by Edison himself. The extreme sensitiveness of the carbon to the slightest changes in pressure gave rise to the hope that the instrument would far exceed in delicacy those previously in use for the detection of minute quantities of heat

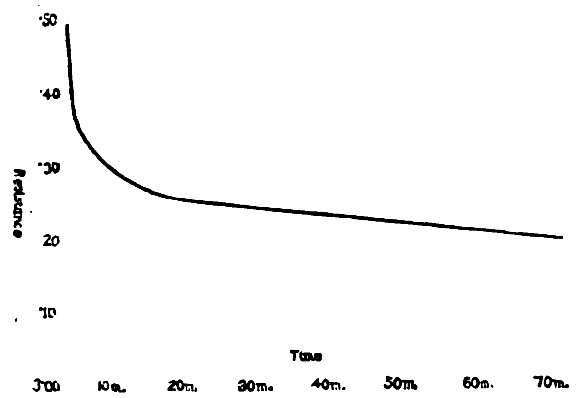
Mr. Edison was a member of the Draper Eclipse Expedition in the summer of 1878, and used his tasimeter during the total eclipse of July 29th in that year, attempting to measure the heat emitted by the sun's corona. His report to the director, Dr. Henry Draper, was published in the Proceedings of the American Association for the Advancement of Science for the same year. This report shows that the attempt was by no means as successful as could have been desired, the principal obstacle being apparently the difficulty in the adjustment of the tasimeter so that the galvanometer needle would remain at zero, and to secure its return to that point after it had been deflected. In fact, the zero adjustment was only made by the use of a peculiar shunt of variable resistance ingeniously contrived by Mr. Edison for the purpose.

The writer is not aware of any other systematic attempt to secure quantitative results through its use, and, as far as known, the instrument has been generally regarded as peculiarly inconstant and unreliable in its indications.

Having in his possession a tasimeter constructed after the model of that described in the report referred to above, the writer undertook a short time ago to investigate the quantitative relation between pressure and resistance for the carbon disc which belonged to it. In a series of preliminary experiments, the use of the toothed wheel and screw, by means of which the pressure is communicated to the disc, was found to be extremely objectionable on account of the impossibility of exactly reproducing a given pressure. This portion of the instrument was, therefore, entirely removed, and an arrangement made by means of which any definite pressure might be quickly brought to bear upon the disc or removed from it. A slender brass rod was placed in a vertical position upon the centre of the upper contact piece, the upper end of which rested lightly in a small conical cavity made on the under side of the scale-pan of a balance. The weight was suspended above by a fine thread passing over a pulley, so that by raising or lowering it the pressure was applied or removed as was desired. The carbon disc was made one of the branches of a Wheatstone's bridge, as described by Mr. Edison. In lowering the weight care was taken to make the movement slow enough to avoid any shock to the disc. When the apparatus stood with the weight lifted, the adjustment of the galvanometer to the zero was made without any difficulty, the resistance of the disc appearing to be quite constant. When the pressure was applied, however, the adjustment became very troublesome, and after a few trials it was discovered that *time* was a very important element in the problem. The addition of a pressure of fifty grams reduced the resistance to nearly one-fourth of what it was in its normal condition *instantly*, but it was found that the minimum was not reached at once. The resistance continued to fall during the first two or three minutes with considerable rapidity, and after that more slowly. A series of experiments was accordingly undertaken for the investigation of this phenomenon. After a number of trials, the bridge was adjusted so that when the key was closed simultaneously with the application of the pressure the needle of the galvanometer would remain momentarily at zero, for the instantaneous effect of this pressure seemed to be quite constant. In a few seconds, however, the needle began to move, showing that the resistance was diminishing. With this constantly decreasing resistance it was, of course, difficult to obtain balances which were very accurate, but generally one could be obtained within a minute after the application of the pressure, and another a minute or two later, and so on. The operation was repeated many times, and a number of points for the curve shown below were obtained, which, though necessarily somewhat scattering, were so situated as to render its general form almost certain. In almost every instance immediately after the removal of the pressure, the normal resistance was again measured, and it was found that while time was necessary for the resistance to reach a minimum after the application of the pressure, the disc seemed to recover its maximum normal resistance instantly upon its removal.

After the construction of the curve showing the relation between time and resistance, and on the supposition that it correctly represents that relation, it was easy to know what the adjustment of the bridge should be at the end of any given time, and thus the difficulty of that adjustment dis-

appeared. When tested in this way, the curve was found to be correct within the errors of experiment. The following table exhibits the resistances after various times, the *instantaneous* resistance being called 100. The resistance



Curve showing the relation between Resistance and Time.

before the addition of the pressure of 50 grams was 11·67 ohms, which immediately fell to 3·52 ohms upon the application of the weight.

Time in minutes.	Resistance.	Time in minutes.	Resistance.
0	100	15	92·0
1	96·6	20	92·5
2	95·4	25	92·3
3	94·9	30	92·1
4	94·5	35	92·0
5	94·2	40	91·8
6	93·9	50	91·5
7	93·7	60	91·2
8	93·6	70	90·9
9	93·4	80	90·8
10	93·3	90	90·7
12	93·1		

It will be seen that the resistance falls a little more than 3 per cent. in one minute, about 5 per cent. in three minutes, and about 10 per cent. in one hour and a half, and it seems tolerably certain that even then a minimum is not reached. In two or three instances the time of continuous pressure was prolonged to twenty-four hours, the resistance at the end being slightly lower than at any previous reading. Finally, the apparatus was left with the weight applied for one week. No measurements were made during that time, but at the end the resistance was found to be decidedly lower than it was at the end of two hours after the application of the pressure, and it is especially to be noticed that on the removal of the pressure the normal resistance of a week before was instantly recovered. In this case the pressure applied was 100 grams. The resistance before the application of the pressure was 11·08 ohms. Upon applying the pressure it immediately fell to 2·34 ohms. In two hours this had been reduced to 2·10 ohms, and at the end of a week it was 1·93 ohms. Thus in two hours it was reduced by about 10 per cent., and after one week it was again about 10 per cent. lower.

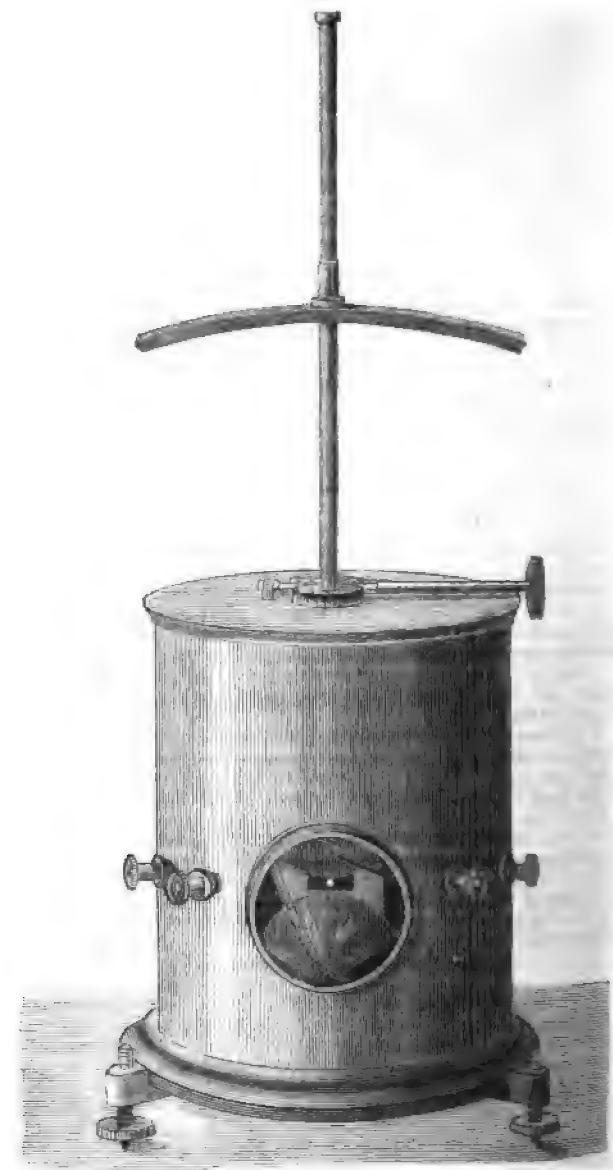
It appears, therefore, that the element of time plays an important part in the phenomena exhibited by the carbon disc, and it seems highly probable that this has been one of the principal causes, if not the chief cause, contributing to the inconstancy and unreliability of the indications of the tasimeter. The experiments made thus far indicate a fair degree of constancy in its results when this factor is considered. The writer hopes to be able to make further examination concerning the extent to which all of the conditions necessary to its use may be controlled.

The resistance of carbon under pressure has been made the subject of investigations recently by Mr. Herbert Tomlinson and Prof. Silvanus Thompson. The conclusion reached by both is that the diminution of resistance is really due to the contact between the electrodes, and it appears that Prof. W. F. Barrett has arrived at a similar conclusion, as a result of experiments made upon a "button of compressed lamp-black." Without knowing anything about the nature of these experiments, the writer desires to record his belief that this theory does not entirely account for the facts stated above. Besides, it seems a little difficult to understand how so small a pressure as 50 grams. added to an already existing pressure of about the same amount can increase the area of contact between a flat plate and a flat disc nearly four times, to say nothing of the "recovery," which takes place so promptly upon the removal of the pressure.—*The American Journal of Science*, Vol. XXIV., July, 1882.

AN IMPROVED THOMSON REFLECTING GALVANOMETER.

By F. J. MUDFORD.

In the ordinary reflecting galvanometer the most important portion of the coil, viz., that nearest the needles, is omitted, partly to make room for the emergence of the light



from the mirror. In the above instrument (of which an illustration is given) I have placed the mirror between the coils, so that I am able to bring the coils almost exactly to the theoretical shape which gives the greatest sensitiveness, the only portion left out being that required for the motion of the needles, which, moving not only much closer to the wire than usual, but so near the metal frame that currents are induced in it which damp the swinging of the suspension.

The suspension can be dropped into its place after the fibre has been made fast, without interfering with the coils.

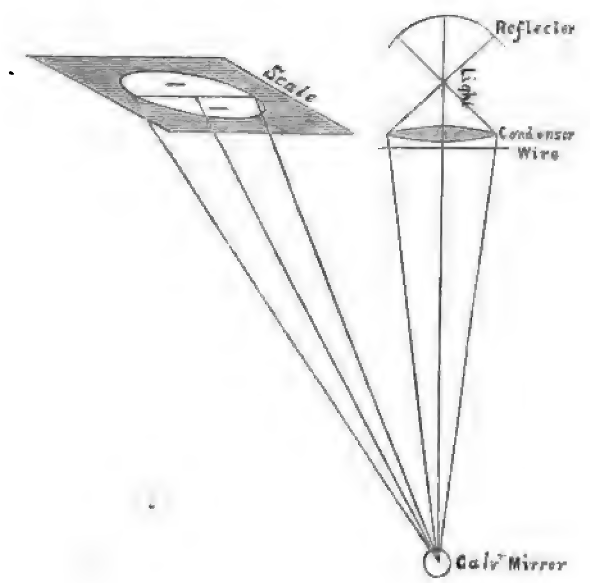
The insulation of the instrument is far more perfect than in the ordinary form, 100 Leclanché cells producing no perceptible deflection when connected to one terminal. This is secured by mounting the terminals, which project through

the case, on long insulating supports, which, being inside, where the air may be dried by means of sulphuric acid, are kept free from dust and films of moisture. When such very high insulation is required, the conical ebonite plugs which slide on the terminal rods are withdrawn (as in the engraving), leaving annular air spaces between the terminals and case.

The instrument is wound with a double set of coils, one of high and the other of low resistance, and is suitable for any purpose to which a sensitive reflecting galvanometer can be applied.

In the optical arrangement of the scale, the condenser has been placed between the object (the fine wire) and the light, certainly the correct place for it, as by placing the object behind the lens, a real image of the virtual, and therefore enlarged image of the wire, is produced upon the scale, a very undesirable result, as the image upon the scale should be as fine and distinct as possible, and not blurred by the interposition of a condenser.

Subjoined is a diagram of the arrangement :—



It will be seen by the above diagram that there is no object in having the image of the light at the galvanometer mirror larger than the mirror, as it is evident that the only part concerned in the brightness of the image upon the scale is what falls upon and is reflected from the surface of the mirror. I have accordingly supplied a lamp, giving a small but intrinsically brilliant flame.

The image of the wire upon the scale will be the same size as the wire itself, as they are both the same distance from the galvanometer mirror which produces the image. It will be found with nearly all scales that this is not so, but that the image of the wire is much thicker than the wire, and frequently blurred. It will thus be seen that the brightness of the image is not affected by alterations in the size of the condenser.

[We have had an opportunity of examining one of Mr. Mudford's galvanometers, constructed by Messrs. Paterson & Cooper, and quite consider that in many respects the instrument is a decided improvement on the existing forms. The addition of a thick wire coil, the high insulation, and the arrangement of the lens so as to obtain a sharp image on the scale, are very great and useful refinements, whilst the disposition of the needles, mirror, and suspending fibre, so that the latter can be easily got at, is an improvement which those who have had the misfortune to break the same would thoroughly appreciate. We cannot agree, however, with two points which are claimed as being of great utility. Mr. Mudford argues that by getting the wire wound very close to the magnetic needles he considerably increases the effect of the current on them. Now this would be true supposing that the magnitude of the coils was small compared with the size of the space within which the magnetic needles swing. The resultant effect of the current on the needles is, however, due to the sum of the effects produced by all the turns of wire ; and inasmuch as the major portion of these turns must in any case be distant from the needle, the *total* result of all the turns is but very little added to by the few extra turns set close to the needles. The fact of the movement of the needles being damped by the contiguity of the metal frame is a great disadvantage when discharge currents have to be measured, and such measurements are of constant occurrence in electrical testing.—Eds. Elec. Rev.]

REVIEWS.

The Watch and Clockmakers' Handbook. By F. J. Britten Fourth edition. London: W. Kent & Co., Paternoster Row, and Grimshaw and Baxter, 35, Goswell Road.

Although the major portion of the information contained in this small work is of comparatively little use except to watch and clockmakers, yet there is much which is of value to those interested in telegraph instrument construction. Most of the electro-mechanical work executed by amateurs bears very clear indications of its being carried out by those whose only training has been in engineering workshops. This arises, as we have before pointed out, from the fact that in colleges and schools where technical instruction is given, the latter is always (we believe there is no exception) of such a nature as only to enable those taught to manufacture or design comparatively heavy machinery. Watch and clockwork, it is perhaps unnecessary to say, is fashioned by tools which are quite unlike those required for ordinary engineering work. It is not at all an uncommon thing for an amateur who has turned his attention to telegraph instruments or clockwork, to wonder why he cannot make his pivots run smoothly and true by turning them in his lathe in the same way as he would the crank shaft of a model engine. He also wonders why it is that he cannot make his model A B C instrument work without its indicator continually lagging behind, or why he requires so much battery power to make it work at all. In fact the amateur can only recognise a steam-engine and a watch as both being machines generally, and being such he imagines that the pieces of each can be constructed by the same tools.

That electrical work is coming very much to the fore is certainly abundantly recognised by the fact that the general subject is taught at almost every school, and also of course at every college where an applied science department exists. We certainly think, however, that in the lectures given on workshop appliances some allusion at least should be made to the watch and clock branch of the subject, and also that in the workshop instruction the elements of clock and watch construction should be taught. The City and Guilds of London Institute is, we believe, the only place at which such instruction is given, and we may mention that the "Watch and Clockmakers' Handbook" is one of the works recommended for the course, a fact which in itself speaks well for the book.

While recognising the utility of Mr. Britten's work we regret that he has not mentioned one or two tools which are almost indispensable for ordinary electrical instrument work ; we find, for instance, no mention made of that most useful hand lathe the "clockmaker's throw." We are also somewhat surprised that the "uprighting" tool is not illustrated or referred to. The study of watch and clockwork is not only most useful, but also most fascinating. In clock mechanism, and especially in old clock mechanism, some most remarkable pieces of human ingenuity exist which are known to comparatively few. How many, for example, know the value of the "epicyclic train"? To those who are especially interested in ingenious pieces of mechanism we would recommend a study of the patents of Sir Charles Wheatstone. In one of these patents (we forget which) is described one of the prettiest pieces of mechanical ingenuity ever devised, but which, we believe, is almost entirely unknown ; we allude to the mechanism devised for enabling an A B C instrument with a large and heavy hand to be worked by the rapidly alternating currents of the Wheatstone A B C magneto transmitter.

A Treatise on the Transit Instrument as Applied to the Determination of Time. By Latimer Clark. Published by the Author, at 6, Westminster Chambers, London, S.W.

The author states that "the motive of this little work is a desire to introduce the transit instrument into more common

use for purposes of utility and amusement, and more especially as a means of obtaining true time for the regulation of clocks and watches." To the uninitiated the contents of the book must look somewhat alarming at first, and one would not be surprised if the amateur purchaser on glancing at it, at once threw it aside as being far too deep for his comprehension. Actually, however, the difficulties to be overcome will be found to be very slight indeed, and we quite think that a large amount of very profitable amusement may be obtained by the help of the volume and the instrument it describes. The fact of the work being brought out by Mr. Latimer Clark must recommend it to the telegraph profession generally.

[Besides the foregoing books, we have also received *The Law Relating to Electric Lighting; being the Electric Lighting Act*, by G. Spencer Bower, B.A., and Walter Webb (London: Sampson Low, Marston, Searle, and Rivington, 188, Fleet Street); *Electric Illumination*, Vol. I., by Conrad Cooke, James Dredge, F. O'Reilly, S. P. Thompson, and H. Vivarez, Edited by James Dredge, chiefly compiled from *Engineering* (Offices of *Engineering*, 35 and 36, Bedford Street, Covent Garden, London); and *Le Siphon-Recorder et la Curb-Sender*, monographie par A. L. Ternant (Paris: Librairie de l'Académie de Médecine, 120, Boulevard Saint-Germain); but owing to the extreme pressure on our columns, we have not yet been able to notice them.—EDS. ELEC. REV.]

REVISED EDITION OF PATENT RULES.

[WE have received the following rules and regulations from Mr. H. Reader Lack, which we think of sufficient importance to publish.]

RULES, REGULATIONS, AND ORDERS FOR THE PASSING OF LETTERS PATENT FOR INVENTIONS.

By virtue of the provisions of the Patent Law Amendment Act, 1852, We, the Right Honourable Roundell Baron Selborne, Lord High Chancellor of Great Britain, the Right Honourable Sir George Jessel, Master of the Rolls, Sir Henry James, Her Majesty's Attorney-General, and Sir Farrer Herschell, Her Majesty's Solicitor-General, being four of the commissioners of patents for inventions under the above-mentioned Act, do hereby make the following rules and regulations:—

GENERAL RULES.

I. The office of the commissioners of patents shall be open to the public every week-day, Christmas Day and Good Friday excepted, from 10 to 4 o'clock.

II. All petitions for the grant of letters patent, declarations, and provisional specifications, shall be left at the office of the commissioners; all specifications in pursuance of the conditions of letters patent, and all complete specifications accompanying petitions for the grant of letters patent, shall be filed at the office of the commissioners.

III. Specifications, copies of specifications, provisional specifications, petitions, notices, and other documents must be written or printed in large and legible characters; and the signatures of the petitioners or agents thereto must be written in a large and legible hand.

IV. Stamp duties payable upon notices to proceed, notices of objection, or warrants and letters patent will not be received in the office of the commissioners after 2 o'clock in the afternoon of Saturdays, nor after 3 o'clock on other days: except that on the last day for the payment of any of such stamp duties they will be received up to 4 o'clock.

APPLICATION WITH PROVISIONAL SPECIFICATION.

V. In every application for letters patent, the title of invention and the provisional specification must be limited to one invention only; and no provisional protection will be allowed or granted where the title or the provisional specification embraces more than one invention.

VI. The title of the invention must point out distinctly and specifically the nature and object of the invention.

VII. In every application for letters patent for an invention which is not the discovery of the applicant, the petition and the declaration must state the source of the invention in one of the forms given at page 11,* or in a form as near thereto as circumstances will admit.

VIII. No amendment or alteration, at the instance of the applicant, can be made in a provisional specification after provisional protection [illegible] been allowed, except for the correction of clerical errors or of [illegible]sions or errors made *per incuriam*. Application for leave to amend [illegible]visional specification or other document must be made to the law [illegible]r to whom the petition for letters patent has been referred.

[illegible]. The provisional specification must state distinctly and intel[illegible]ly the whole nature of the invention, so that the law officer may be apprised of the improvement, and of the means by which it is to be carried into effect.

X. Every provisional protection of an invention allowed by the law officer shall be forthwith advertised in the *Commissioners of Patents' Journal*; and the advertisement shall set forth the name and address of the applicant, the title of his invention, and the date of the application.

XI. Where an applicant for letters patent, after obtaining provisional protection, shall give notice in writing at the office of the Commissioners of his intention to proceed with his application for letters patent, the same shall forthwith be advertised in the *Commissioners of Patents' Journal*; and the advertisement shall set forth the name and address of the applicant and the title of his invention, and that any persons having an interest in opposing such application are to be at liberty to leave particulars in writing of their objections to the said application at the office of the commissioners, within twenty-one days after the date of the Journal in which such notice is advertised.

XII. The notice of the applicant of his intention to proceed for letters patent must be left at the office of the commissioners within four calendar months from and after the date of application; and the application for the warrant of the law officer and for the letters patent must be made at the office of the commissioners twenty-one days at the least before the expiration of six calendar months from and after the date of application: Provided always, that when the last day for giving such notice or making such application falls on Sunday, Good Friday, or Christmas Day, such notice may be given or application made on the following day: Provided also, that the Lord Chancellor may in either of the above cases, upon special circumstances, allow a further extension of time, on being satisfied that the same has become necessary by accident, and not from the neglect or wilful default of the applicant or his agent.

DIRECTIONS as to *Sizes* and *Methods of Preparing* PETITIONS, DECLARATIONS, PROVISIONAL SPECIFICATIONS, DRAWINGS to accompany Provisional Specifications, and COPIES thereof.

XIII. All petitions for the grant of letters patent, all declarations, and all provisional specifications, shall be respectively written or printed upon sheets of paper of twelve inches in length by eight inches and a half in breadth (but on one side only), leaving a margin of one inch and a half on every side of each page.

XIV. The drawings accompanying provisional specifications shall be made upon a sheet or sheets of parchment, drawing paper, or cloth, each of the size of twelve inches in length by eight inches and a half in breadth, or twelve inches in breadth by seventeen inches in length (but on one side only), leaving a margin of one inch on every side of each sheet.

XV. The copy of the provisional specification, to be left at the office of the commissioners with the provisional specification, shall be written or printed upon sheets of brief or foolscap paper, briefwise, and upon one side only of each sheet.

XVI. The copy of the drawing or drawings, to be left with the copy of the provisional specification, must be made upon good white smooth-surfaced drawing paper of the same dimensions as the original drawing. All the lines must be absolutely black, Indian ink of the best quality to be used, and the same strength or colour of the ink maintained throughout the drawing. Any shading must be in lines, clearly and distinctly drawn, and as open as is consistent with the required effect. Section lines should not be too closely drawn. No colour must be used for any purpose upon this drawing. All letters and figures of reference must be bold and distinct. The border lines should be one fine line only. The drawing must not be folded, but must be delivered at the office of the commissioners either in a perfectly flat state or rolled upon a roller, so as to be free from creases or breaks.

XVII. In all cases where the original drawing is coloured, there must be left, in addition to the above copy, another copy coloured.

DIRECTIONS as to *Sizes* and *Methods of Preparing* SPECIFICATIONS in pursuance of the conditions of LETTERS PATENT, DRAWINGS to accompany the same, and COPIES thereof.

XVIII. All specifications in pursuance of the conditions of letters patent, shall be respectively written or printed bookwise upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth; the same may be written or printed upon both sides of the sheet, but a margin must be left of one inch and a half on every side of each page.

XIX. The drawings accompanying such specifications shall be made upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth, or twenty-one inches and a half in breadth by twenty-one inches and a half in length (but on one side only), leaving a margin of one inch and a half on every side of each sheet.

XX. The copy of the specification, to be left at the office of the commissioners on filing the specification, shall be written or printed upon sheets of brief or foolscap paper, briefwise, and upon one side only of each sheet.

XXI. The copy of the drawing or drawings, to be left with the copy of the specification, must be made on good white smooth-surfaced drawing paper of the same dimensions as the parchment drawing. All the lines must be absolutely black, Indian ink of the best quality to be used, and the same strength or colour of the ink maintained throughout the drawing. Any shading must be in lines, clearly and distinctly drawn, and as open as is consist[illegible] with the re[illegible] effect. Section lines should not be too closely [illegible]. N[illegible] must be used for any purpose upon this drawing. [illegible] figures of reference must be bold and distinct. [illegible] should be one fine line only. The drawing m[illegible] but must be delivered at the office of the commi[illegible]

* In Pamphlet.

perfectly flat state or rolled upon a roller, so as to be free from creases or breaks.*

XXII. In all cases where the original drawing on parchment is coloured, there must be left, in addition to the above copy, another copy coloured.

APPLICATION WITH COMPLETE SPECIFICATION.

XXIII. Every application for letters patent, with complete specification, must be limited to one invention only; and no warrant will be granted where the title or the complete specification embraces more than one invention.

XXIV. The title of the invention must point out distinctly and specifically the nature and object of the invention.

XXV. In every application for letters patent for an invention which is not the discovery of the applicant, the petition and the declaration must state the source of the invention, in one of the forms given at page 11, or in a form as near thereto as circumstances will admit.

XXVI. Every invention protected by reason of the deposit of a complete specification shall be forthwith advertised in the *Commissioners of Patents' Journal*; and the advertisement shall set forth the name and address of the applicant, the title of the invention, the date of the application, and that a complete specification has been deposited.

XXVII. Where an applicant for letters patent, after deposit of a complete specification, shall give notice in writing at the office of the commissioners of his intention to proceed with his application for letters patent, the same shall forthwith be advertised in the *Commissioners of Patents' Journal*; and the advertisement shall set forth the name and address of the applicant and the title of his invention, and that any persons having an interest in opposing such application are to be at liberty to leave particulars in writing of their objections to the said application at the office of the commissioners, within twenty-one days after the date of the Journal in which such notice is advertised.

XXVIII. The notice of the applicant of his intention to proceed for letters patent must be left at the office of the commissioners within four calendar months from and after the date of application; and the application for the warrant of the law officer and for the letters patent must be made at the office of the commissioners twenty-one days at the least before the expiration of six calendar months from and after the date of application: provided always, that when the last day for giving such notice, or making such application, falls on Sunday, Good Friday, or Christmas Day, such notice may be given, or application made, on the following day: provided also that the Lord Chancellor may in either of the above cases, upon special circumstances, allow a further extension of time, on being satisfied that the same has become necessary by accident, and not from the neglect or wilful default of the applicant or his agent.

(To be continued.)

THE PATENT ELECTRIC GAS IGNITING COMPANY (LIMITED).

FOR some weeks past the investing public has been comparatively free from the natural embarrassment of deciding which of several competing electrical companies offering shares at the same time best deserves support.

As the period when this was the case has barely gone by, investors have no doubt a lively recollection of what they expected in return for their money, and they have now experienced for the most part the truth of the text, "Blessed is he who expects nothing," &c.

The above remarks will of course be understood to apply chiefly to electric light companies, and it is therefore somewhat of a relief to turn to anything proposed for the employment of electricity in other ways, even though it be a means for lighting gas.

The prospectus of the Patent Electric Gas Igniting Company is before us, and the company's object is primarily "to acquire as going concerns the undertakings and patents of the 'Electric Gas Lighting Company (Limited),' Manchester, and the 'London and Provincial Electric Gas Lighting Company (Limited),' London, and also to acquire the rights of the patentees in the portable batteries, improved induction coils, and machinery for producing the same. By this purchase the company will secure the exclusive right of manufacturing and selling Clarke's patent electric gas lighting apparatus and portable battery, induction coil, and coiling machine for *all parts of the world* where patents have been or may be obtained."

The advantages of lighting gas by means of electricity or, more properly speaking, by means of the electric spark, are set forth in the company's prospectus as follows:—

1st. It affords a complete safeguard against fires from the careless use of matches, paper, tapers, &c., for lighting gas; the destruction and soiling of table-cloths, carpets, furniture, billiard tables, &c., from droppings of grease and sparks, caused by igniting gas with matches, tapers, and the other appliances now in use.

2nd. It can be used without risk of explosion in all factories, as it will ignite gas only; it will not even ignite the explosive part of an ordinary match.

3rd. Its economy; owing to the lasting powers of the lighter.

4th. Its perfect adaptability also to the purposes of street lighting, as it can be used for that purpose in any wind and in any weather.

As we understand the apparatus from the drawings which accompany the prospectus, it appears to consist electrically of a small battery and an induction coil. These are apparently contained in a case of telescopic form from the end of which protrudes a tube or rod, having arranged at its end two points for a spark to jump between. On the case is a press-button, which we presume takes the place of the ordinary "make" and "break" arrangement of an induction coil. The instrument looks neat and is so far simple enough. We remember some years ago an attempt to introduce an electric "gas lighter," constructed on the principle of the "electrophorus." This was also exceedingly simple, but it was not always to be depended upon for certainty in its action. It was necessary to keep it quite dry, and it frequently failed completely for no apparent reason. When in good condition it was oftentimes a matter of difficulty even then to light the gas, for it was necessary that one should have attained considerable facility in its use to make sure of igniting the gas without many failures. If we are not mistaken, Messrs. Strode & Co., the "well-known gas and electric engineers"—to quote the words of the prospectus—who are so favourably impressed with the value of the present invention, that they concluded a contract with the London and Provincial Electric Gas Lighting Company to manufacture and sell the apparatus throughout the entire district of London and the South, and to meet all demands that might arise for the same; were prominently connected with the "Electrophorus" gas igniter of which we have just spoken.

Returning to the new company's project, we find that the terms of purchase, for the two businesses, the factory, patents, patent rights, goodwill, &c., and the rights of the patentees, have been fixed, as modified, at £75,000, payable as to £29,920 in cash, and as to £45,080 in shares, and this price includes all expenses of the formation of the company. The total capital of the company is £100,000, in 20,000 shares of £5 each, and this is the way in which it is expected great profits will be derived.

1st. In the manufacturing and selling, and the licensing of others to manufacture and sell the various forms of lighting apparatus, induction coils, coiling machines, portable batteries, and portable electric bells, in the United Kingdom of Great Britain and Ireland.

2nd. In the selling of patents or licences for foreign countries, the Colonies, and British Dependencies.

Patents have already been obtained for the United Kingdom, France, Belgium, Germany, Italy, Austria, and the United States of America, and it is proposed that these patents, together with those for which application has been made, or which may hereafter be obtained, should be from time to time disposed of by the company.

By these means alone it is confidently expected that an amount exceeding the whole of the capital will be returned to the shareholders, who will, in addition, continue to receive from the profits of the manufacture, dividends which, it is estimated, will be at a rate rarely reached by any joint stock company.

The first issue of shares will be 16,000. Of these 9,016 are taken, fully paid, by the vendors, in part payment for the properties, 5,839 have been already subscribed, leaving only 1,145, which are now offered for public subscription at par.

We would first of all call attention to the manner in which it is *confidently expected* that an amount exceeding the whole of the capital will be returned to the shareholders.

* N.B.—The commissioners of patents having decided that the drawings accompanying the provisional, complete, and final specifications of 1876, and subsequent years, shall be copied by the process of photo-lithography, this regulation must be strictly observed, in order that correct copies may be made. [illegible]fications and drawings filed in pursuance of letters patent should be left at [illegible] of the commissioners at least six days before the expiration of the time [illegible] the same, in order that the officers may examine the extra copy of the [illegible] and ascertain that it has been prepared in conformity with the rules.

Cannot any firm or private individual manufacture a "gas igniter," made up of a battery, induction coil, and any suitable arrangement for the sparks to fly across? We say, yes, decidedly; and therefore the matter resolves itself into one of using a special form of battery, or a special induction coil, and the question is simply then the worth of such patents. Of course a going concern, independently of patents, may be exceedingly valuable, but on the face of it we cannot see this factor in the double business about to be acquired by the company.

It is said that the apparatus is in extensive use in Manchester and district, but this does not prove much. It appears to us, rightly or wrongly, that when the figures we have given above concerning the issue of shares are analysed, the working capital to carry on this valuable business amounts to £5,000. Is this the amount which it is confidently expected will be exceeded? From the large proportion of the first issue of shares taken by the vendors and privately subscribed, one might almost fancy that vendors and purchasers are too closely allied.

We feel assured when looking at some of the names on the board of directors that everything has been proposed in good faith as far as the public is concerned, but we cannot look upon the undertaking as one which will eventually prove the correctness of the promoters' views. On the contrary, contrivances for gaslighting by electricity have been numerous enough, but we do not know of the permanent success of any. Therefore the price asked by the vendors for the resurrection of an old idea dressed up anew appears to be quite out of all proportion to its value, and although the shares now offered to the public amount to less than £6,000 in value, we are inclined to think that better ways might easily be found for investing such a sum even in the electrical world.

THE BRUSH COMPANIES AND THE LANE-FOX LAMP.

DURING the last few weeks the reports of the subsidiary Brush companies' meetings must have proved, to any one connected with the subject of electric lighting, very interesting.

To most of our readers it is probably by this time well known what effect the letter of Sir Charles Bright, contained in our issue of October 7th, has primarily had. Certain individuals, either from *bonâ fide* motives or from the desire to get back their money invested in the Brush subsidiary companies (the shares of which are in most instances quoted at a discount), or perhaps for the sake of making some immediate *profit*, filed petitions for the winding-up of the companies in which they respectively hold a few shares. With their motives we have at the moment nothing to do, but the expressed views of the Chairmen of those companies which have had meetings since, and in consequence of the appearance of the aforesaid letter, comprise much that is noteworthy and also (bearing in mind the social positions of some of the speakers) much that is surprising. If a company buys two things, each for, say, £50,000, and one of those two things is afterwards proved to have been bought through negligent or wilful misrepresentation on the part of the vendor, surely the vendor is liable for any direct or indirect loss the purchaser may have made through such negligent or wilful misrepresentation. It is poor consolation and quite beside the mark to say, as have some of the speakers at the recent shareholders' meetings, that the Lane-Fox patent is no longer of much value.

If this latter statement be true, and we see no reason to contradict it, what an enormous sum of money these infant "Brushes" must have squandered, for what else have they obtained for their money? The right to use the Brush dynamo and the Brush arc lamps! The former in danger from competition with newer fashioned machines, less costly to construct, and the latter one pattern of many, about equal in value so far as their practical utility is concerned. However, the question, which none of the boards of directors seem fairly to ask themselves is, what, in the interest of the shareholders, is it their duty to do? Mr. David Evans, who was a director of the Birmingham and Warwickshire Electric Light Company, was apparently the only man who recognised what his duty was. His speech, as reported on p. 424 of our issue of Nov. 25th, we recommend to some of those who presided over the various meetings, and who endeavoured, in a weak manner, to argue away the extent of the loss incurred through their negligence, or oversight, by trying to prove that the property so obtained was worth nothing. It may be to many very unpalatable, but we cannot insist too strongly that the Chairmen and directors of these subsidiary companies are the trustees of their shareholders' interests, and that any miserable patching up, or slurring over of the present crisis, will probably only delay, for a time, that reckoning with their shareholders which the Lane-Fox incident had almost precipitated.

At the meeting of the Brush Electric Light and Power Company of Scotland, reported in our last issue, a shareholder said he had heard "that one company had already obtained on account of the Lane-Fox blunder the sum of £21,000," which statement was met by cries of "No, no," and a director answered, "Not a penny." The director was right, it would appear, but to what extent was he right? Well, we have before us, at this moment, a circular issued by the directors (through their secretary) of one of the Brush companies, in which they distinctly say they unhesitatingly recommend its (the £21,000) acceptance. So the director was only correct thus far—the money was not then *actually paid;* we give however this circular, for it is of importance as showing the disposition of those responsible to the shareholders to get out of their difficulty in any way easiest to themselves. It may however be remarked that the easiest way is not always the most profitable to the shareholders. The italics in the circular are ours.

TO THE SHAREHOLDERS OF THE BIRMINGHAM AND WARWICKSHIRE BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).

DEAR SIR,—Consequent upon the resolutions passed without a single dissentient at the extraordinary general meeting of shareholders of this company, held on Wednesday last (a full report of which accompanies this circular), at which meeting upwards of 34,000 shares, out of a possible total of 38,000, were represented, either in person or by proxy, your directors have lost no time and spared no pains in endeavouring to bring to a successful issue the negotiations then pending with the vendors in reference to the Lane-Fox licence, and I now have great pleasure in stating that an offer has been made by them (the vendors) for the *re-purchase of the same* for the sum of £21,000, payable as to £4,000 in cash, and £17,000 in shares of the company.

This offer is, in the opinion of your directors, not only fair and reasonable, but even advantageous, and they unhesitatingly recommend its acceptance forthwith; but, as stated by your chairman at the meeting, your directors are most anxious that in any important step of this character which they may take, they should have the entire concurrence of the general body of their constituents, therefore, before closing with this offer (which they otherwise would do at once), they would be glad to have the expression of your views thereon, upon the accompanying form, and failing the receipt of any such expression by Wednesday next, the 29th instant, they will treat your *silence as corroboration of their action.*

It may be pointed out that the maximum profit which would accrue to this company by retaining the Lane-Fox licences and attempting to introduce the Lane-Fox lamps would be a commission of 10 per cent. on the lamps sold. The price of the lamp is 5s.; it will therefore be seen at a glance that 840,000 lamps would have to be sold before the equivalent of £21,000 now offered could be realised by this company, exclusive of the attendant expenses, and the re-sale of the licences would also at the same time leave this company perfectly free to supply the best lamp which at any time might be in the market, on which it would, of course, also secure the trade discount.

I would also desire to point out that by the arrangement here contemplated, your directors avoid on the one hand the necessity of plunging the company into a tedious and lengthy litigation with the vendors, the issue of which would be doubtful but the expense certain, and on the other the alternative of the inevitable winding-up of the concern, a course directly antagonistic to the unanimous wishes of an overwhelming majority of the shareholders, and one which, after the unanimity evinced at the extraordinary general meeting, need, the directors believe, be no longer seriously contemplated; and I am authorised to reiterate the statements made by your chairman, viz., that not one penny-piece has been or will be paid away in settling or compromising any of the vexatious actions which have been or may be brought against the company.

I am, dear Sir, yours faithfully,

H. W. ATKINS, Secretary.

110, Cannon Street, London, E.C.,
November 25th, 1882.

We have no disposition to object to the kind of [illegible] referred to in the above circular, and provided a [illegible] return of *cash* as well as shares is made (for [illegible] remembered that nearly all such shares [illegible] heavy discount), it might be advisable for t[illegible] to accept such offers; but we do strongl[illegible] the Chairmen and directors trying to [illegible] culty by recommending to their [illegible] *anything* which may appear to [illegible] commi[illegible]

question at issue. In conclusion, we append a tabular statement, which at this time may be interesting, and also useful in aiding our readers to form an idea of the worth of the offers made to them.

Company.	Nominal Capital.	Shares.	Issued.	Calls paid.*	Considered as paid.	To Vendors.
	£	£	£	£ s.	£	£
Great Western Electric Light Co. ..	250,000	5	125,000	53,579	15,000	19,000 cash 15,000 shares
South Eastern Electric Light Co. ..	100,000	5	100,000	31,300		12,750 cash 2,000 shares
Brush Midland Electric Light Co. ..	250,000	5	125,000	31,450	18,000	22,750 cash 18,000 shares
Birmingham & Warwickshire Electric Light Co.	100,000	2	100,000	30,428 10	45,000	15,000 cash 25,000 shares
Staffordshire & Worcestershire Electric Light Co. ..	200,000	2	200,000			30,000 cash 32,000 shares
Yorkshire Brush Electric Light and Power Co.	300,000	2	200,000	122,943 10		37,500 cash 37,500 shares
Brush Electric Light Co. of Ireland ..	250,000	5	Seven shares only subscribed as per Articles of Association.			
Brush Electric Light and Power Co. of Scotland	300,000	5		55,000	20,000	15,000 cash 40,000 shares
Devon & Cornwall Electric Light and Power Co.	100,000	5	100,000	18,903		7,500 cash 7,500 shares

* Compiled from Official Returns made at Somerset House.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

THE ELECTRIC LIGHT IN DUNDEE.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I was surprised to see in your issue of [illegible]vember 25th a rather sharp editorial note on the lighting [illegible] [illegible]mmercial Street, Dundee, by the Brush arc system. [illegible] [illegible]ccount appears to be taken of the fact that the in[illegible] is not a permanent one, but improvised with a [illegible]ble engine and dynamo for a month's trial. [illegible]ng, moreover, appears to give general satisfac[illegible]inly I have myself never seen the Brush arc [illegible]er and give a better effect than they do in Dundee. The illumination is strong, powerful, and steady, and at the height of 20 feet, at which the lamps are fixed, the angle of greatest intensity is most advantageously placed.

My opinion, which may be influenced, is supported by that of strangers from London, who have expressed their admiration at the light and its superiority over many of those of the metropolis.

I was determined not to disappoint the people of Dundee by delaying lighting up, though the night on which steam was first raised was blowing a heavy gale of wind and rain such as made any attempt to adjust the lamps impossible.

Faithfully yours,
E. D. BECKINGSALE,
General Manager and Electrician.

Dundee, *November 29th*, 1882.

ELECTRICAL ENGINEERING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Referring to a letter published in your issue of November 25th, signed "Yoshi," I beg to state that I have myself noticed in many of the electric light installations evidences of a want of the most elementary practical knowledge on the part of those intrusted with the work, and I feel convinced that more than half the failures and so-called accidents may be traced to inefficient workmanship.

I notice also in the same issue a letter from one of the City and Guilds students, complaining that sufficient practical instruction is not given. Will not this in some measure account for the former?

It is a pity electric light companies will not forego some of the prejudice they appear to have against the employment of old tried telegraph engineers, as one ounce of practice is worth a pound of theory; and many of these possess both. I enclose my card, and remain,

Yours truly,
November 30th, 1882. X.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—The replies to your request for information as to electric engineering classes seem to show a very unsatisfactory state of things at Cowper Street, and Mr. Cockburn's letter may not receive the credence to which it is entitled, he being an official of the laboratory.

I am glad to say that my experience of Cowper Street was very different to that related by "Sea Boots" and "F. W. F." I attended the electrical engineering classes there in 1880-81, and learned a great deal from them. The lectures were clear, well arranged, and easy to follow; my only complaint at the time was that Professor Ayrton was only too ready to repeat, in answer to questions, what he had already clearly gone through. There were few experiments at the lectures for the reason that they mainly dealt with subjects requiring quantitative results. Such experiments cannot be performed on the lecture table to any good purpose. In the laboratories, too, the apparatus for each experiment was all carefully arranged, and written instructions concerning them attached. Copies of these instructions could also be obtained for reference in working out the results. The instructions clearly described the method (connections, &c.) of experiment, the results to be noted, and the method of using the results in tables, graphic records, &c. In addition, both the professor and the demonstrators were always in my experience ready to make clear any difficult point, answer questions, and make suggestions to the students. Care was taken that the experiments were carried out properly. Questions too were given every week by Professor Ayrton, arising out of his lectures, such questions being designed to show the students the practical value of the theory taught. As to the objection that theory is not wanted in such lectures, I must differ from "F. W. F." The mechanical construction of lamps and machines is easily learnt in practice, the theory of their action is not.

Professor Ayrton taught me much that I have never seen in print, at least in an intelligible form. It may be in some works, but wrapped up in f's, d's, and other mathematical formula not understood of the many.

The real cause of the dissatisfaction expressed by "F.W.F." and "Sea Boots" is doubtless the overcrowding at Cowper Street. I should be very sorry to be one of 300 students in the temporary class rooms and laboratories.

I am, yours truly,

HENRY M. SAYERS.

Grove Road Chambers, Eastbourne.
December 5th, 1882.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—"Sea Boots" so thoroughly endorses all that I said in respect of the classes at the City and Guilds of London Institute, that I do not deem it necessary to make any comment upon Mr. Cockburn's criticism of my letter.

As regards the query expressed by "Sea Boots," I am only attending the Friday evening lectures at present.

Yours faithfully,

F. W. F.

London, *December 6th*, 1882.

THE LANE-FOX EPISODE.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your last issue in the report of the meeting of the Scottish Brush Light Company, I read that a statement was made by a shareholder that the sum of £21,000 had been offered to rectify the Lane-Fox blunder in another company. This statement appears to have been met with cries of "No! No!" and "Not one penny!" from the chairman.

The statement *is* absolutely true. The directors of the Birmingham and Warwick Brush Company have submitted to the shareholders a proposition made by the Hammond Company for the re-purchase of the Lane-Fox lamp. For this re-purchase the Hammond Company have offered the sum of £21,000.

Taking into consideration the enormous sum received by the Hammond Company out of the Birmingham and Warwick Company's capital, the sum of £21,000 may possibly be considered as, comparatively speaking, "Not a penny!" as the offer is totally inadequate to compensate for the mis-statement.

Yours truly,

"POST TENEBRAS, LUX!"

ARC AND INCANDESCENT LAMPS ON THE SAME CIRCUIT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—May I be permitted to claim that this company (the Manchester and District Edison Electric Light Company, Limited) is equally with Mr. Gülcher's, able to meet the requirements of the public, inasmuch that for some months past we have had in two installations both arc and incandescent lamps fed from the same mains and with most satisfactory results?

Yours truly,

M. RUDDLE,

Electrician to the Company.

Manchester, *December 4th*, 1882.

THE SEA—A SOURCE OF POWER.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—Such a subject as the above is one which should prove of interest to and worthy of the attention of your readers, for as engineers we are continually being called upon to deal with power in one or other of its various forms, and it behoves us ever to be on the alert to investigate any new source of energy, or method of application of existing forces, that may come under our notice.

I have, therefore, much pleasure in directing your attention to what will, I think, when taken in hand by able men, be found a source of immense power. I refer to the sea, and no one can doubt that when agitated by a gale of wind great power is there developed, but the question is how to take advantage of it; and unless we admit that word "impossible," so seldom found in the engineer's dictionary, we can overcome the obstacles that present themselves, and reap the advantage of this great force of nature.

The practical details of such a scheme form the chief detriment to its successful application, and I must here explain that, in introducing this subject to you, I wish it understood that my main object is that by open discussion we way settle this question, "Can the energy of the waves be turned, by the appliances of modern science, into a form applicable to the present demand for motive-power?"

In considering this question we must not overlook the fact that it is but the utilisation of the great power of nature by a new method. Hitherto, in using coal we have been, as George Stevenson remarked about his locomotive, "using the power of the sun from a reservoir which has been an immense time in the course of preparation;" and who shall say that the ingenuity of man cannot discover and tap other reservoirs at present unsuspected.

Our coal fields may in course of time be worked out, but the natural causes that formed them have not ceased, and so we must look for other means of obtaining the advantages of their action.

Now, those who have seen a storm at sea have no doubt been struck with the immense forces at work there; in fact, it is in a hurricane at sea that the power of nature appears the most formidable, and an engineer is well aware that to throw about a ship and cargo, weighing perhaps 5,000 tons, demands an expenditure of energy that makes our most powerful efforts sink into insignificance.

Of course, it may be objected that this action is not constant; in reply, I can only say we might as well argue that because rain does not continually descend men must die between the showers.

You will see, gentlemen, I mean a storage reservoir is required, and recent discoveries in electricity have made its accomplishment possible. First, it is necessary to ascertain accurately the motion of the wave, that we may decide as to the most effectual manner of utilising its force.

The diagram shows by the upper full curved line the surface of a wave of the following properties:—

Velocity 20 knots per hour, or 33·76 ft. per sec.
Length 224·7 feet
Height 18·7 feet
Period 6·58 seconds.

Each of the other full curved lines represents a sub-surface of equal pressure, and it will be here noticed that the movement of a particle at the surface is great, whilst as the depth increases it becomes less and ultimately insignificant.

The still water level is shown by a full horizontal line, and the dotted vertical lines divide still water into eight equal and rectangular blocks, which assume the positions shown by the full inclined and slightly curved lines when disturbed by the wave.

The surface particles have a circular motion through an orbit, of which the height of the wave is the diameter; for sub-surfaces the motion is exactly similar, but proportionately less, as shown, the horizontal level of their centres is slightly above still water level, owing to the crests of waves having a more peaked form than their trough. The motion of elevation and depression of a particle is part of its circular motion, which motion is indicated in the diagram by dotted circles, and their comparative movement of particles for different depths is approximately found thus:—

Let motion at surface equal 1,
at depth equal to $\frac{1}{9}$ length of wave it equals $\frac{1}{2}$
" " $\frac{2}{9}$ " " $\frac{1}{4}$
" " $\frac{3}{9}$ " " 1/[illegible]
" " $\frac{4}{9}$ " " $\frac{1}{16}$
" " $\frac{5}{9}$ " " $\frac{1}{32}$

and so on, so that any substance at the surface would move the whole height of the wave, and at a depth equal to the length of the wave its motion would be only about a 512th part as much.

The effect of a forward motion of a quarter of a wave length is shown on the diagram by long dashes — — —, from which can be seen the change of position of any particle and the circular path it has travelled.

In the centre of the diagram is shown the greatest variation that takes place in any body of water with this size

of waves, that is, the shape of the water at the trough and at the crest are compared.

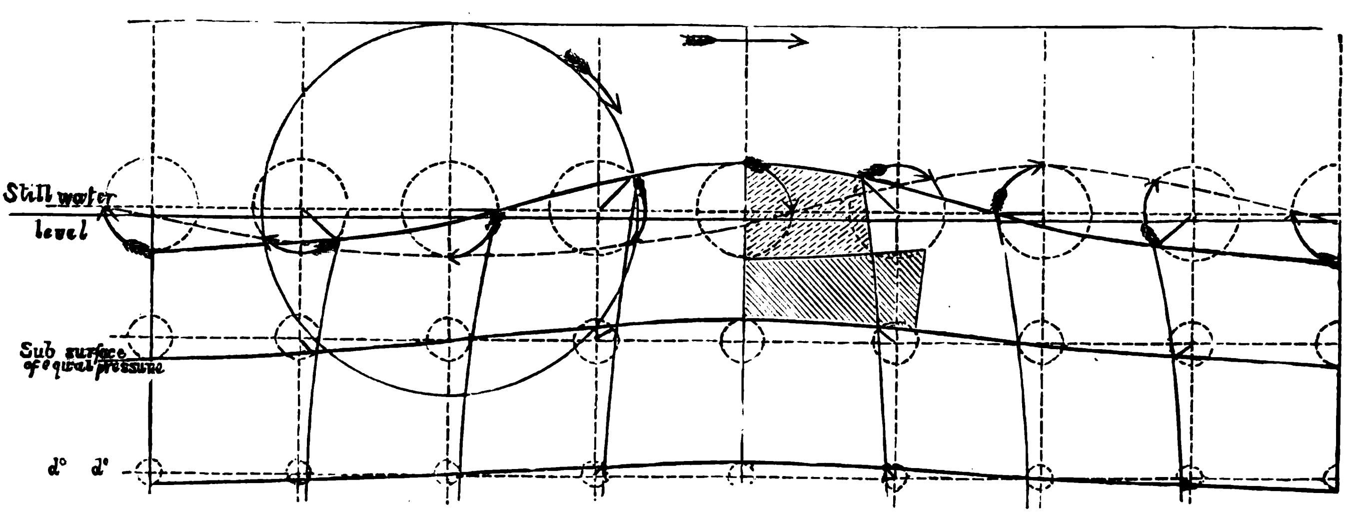
The particles at the surface of such a wave move at the rate of 8·7 feet per second through their circular orbit.

The mechanical energy in a mass of water of given area and unlimited depth agitated by such waves is thus found: Multiply the area by one sixteenth part of the square of the height of the wave and by the heaviness of the fluid (64 lbs. per cubic foot for sea water).

Take a square having sides of 100 feet length, which encloses an area of 10,000 square feet. Multiply this 10,000 by the square of the height of the wave divided by 16, that is, by 349·69 divided by 16, or 10,000 times 21·8, giving 218,000. This result is to be multiplied by 64, the weight per cubic foot of the fluid, which makes 13,952,000 lbs.

One half of this energy consists in elevation, the other half in motion.

The amount 13,952,000 found above, I take means that an expenditure of that amount of energy is necessary to counteract the force of the wave, and the waves have a period of 6·58 seconds, that is, whatever position they may occupy at any given time, the same effect takes place at regular intervals of 6·58 seconds, or the sea has, so to say, 9 revolutions per minute, which multiplied by 13,952,000 and divided by 33,000, gives the horse-power developed, the result being 3,835 horse-power, an enormous amount if we can fully utilise it.



It may be thought that I have taken a wave size that would be seldom available, so I will add a few comparisons.

Observe in the North Atlantic record waves of 24 and 30 feet high, highest being 43, mean 18, in westerly gales.

In the Pacific ... ... 32 feet is recorded.
South Atlantic 22 " "
Cape Horn ... 32 " "
Mediterranean 14½ " "
German Ocean 13½ " "

and French sailors mention 36 feet in the Bay of Biscay. Now I have taken 18·7 feet, about the mean height of Atlantic waves in westerly gales.

From this diagram and calculations you see, gentlemen, just the motions of the wave and the power in them. The question now is to design an apparatus to take advantage of it.

There can be no doubt of the importance of this subject, as it is plain that the time has now arrived when cheap methods for the artificial production of electricity are urgently required, and the invention or discovery of a simple and effective converter of natural energy into electricity will be a great step towards rendering this motive-power the principal one of the age.

The following from the *English Mechanic* of September 9th, 1881, will show how such a subject is regarded.

"There is abundant evidence in the proceedings at the meeting of the British Association to show that we are on the eve of a great revolution in our methods of utilising the available sources of energy. Sir W. Thomson and Sir W. G. Armstrong both addressed themselves to an elucidation of questions which are just now attracting the attention of mechanical engineers and physicists, and the modern developments of electric science warrant the tone of confident anticipation in which the two presidents spoke to their respective sections."

The suggestions of Dr. Siemens that it is possible to utilise the gigantic power of such a waterfall as that of Niagara, have given rise to speculations which in the immediate future will play a very important part, and the recent exhibitions in Paris and Munich will direct the attention of many minds to a subject of growing interest.

Sir W. Thomson has reviewed the sources of energy which man can utilise, and dwelt with special emphasis on the value of wind and water-power in combination with the artificial production of electricity.

Sir W. Armstrong has drawn attention to the fact that we had nearly reached the limit of possible development of the steam-engine. He also says if we could produce electricity with the same facility and economy as we can produce heat the gain would be enormous, and the question then arises whether we cannot actuate dynamo machines by natural forces and save our coal for other purposes. As a secondary motor, the dynamo machine has already been utilised in several ways, and if we can actuate it by some power which is at present allowed to run to waste the gain will be just the value of the coal and the interest of the capital that would otherwise be expended in laying down motive-power engines. Of the available sources of energy other than fuel, we have wind-power, water-power, and tidal-power, but so far as the latter is concerned it is, as Sir W. Thomson has shown, comparatively insignificant.

In wind-power and water-power we have agents which cost nothing, and though as far as the latter is concerned in the country best known to me (Australia) we had little more than the power of running water, the former may possibly, with the aid of recent inventions, be turned to good account.

It is not improbable that further investigations may lead to greater improvements in accumulators, and then electricity will become the motive-power *par excellence* and steam will cease to be "King," though he will doubtless remain Prime Minister for many years.

I think, gentlemen, you will see from the above that this sort of subject is agitating scientific minds, and its importance cannot be exaggerated. I therefore conclude with the hope that Electrician and Engineer may put their heads together, and add that it is my firm belief that one of the most important questions they can settle is

"What are the wild waves saying?"

C. SCOTT SNELL.

FRÂGVIS.—The number of poles per mile on the General Post-office twisted telephone circuit between Manchester and Liverpool averages 27, the distance between the poles therefore averages about 66 yards; the complete twist is completed every four poles length. There is no book which completely enters into the question of the laws which govern the lines of magnetic force and the theory of dynamo-

electric machines based on those lines; opinions differ very considerably on the subject, you would probably get most information, however, from "Electric Illumination," Vol. I., edited by J. Dredge and published at the offices of *Engineering*, 35, Bedford Street, Covent Garden, London, W.C. You must have misunderstood the meaning of the statement which you say is found in most text-books, what it is probably intended to explain is that the current produced by induction is only a momentary one, and that as long as the current continues to flow without change in strength in the circuit which has caused that induction current to be set up, then no further induced current will be generated, or that *one* circuit cannot induce more than *one* current in *one* other circuit at the same time. As a matter of fact, if there were 20 wires in the proximity of a single wire through which a current was caused to flow, induction currents would be set up in all the 20 at the moment when the current commenced or ceased to flow, or when it varied in strength. There is no book which treats of the subject of induction with particular reference to telephone circuits.—EDS. ELEC. REV.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

SOCIETY OF ARTS.—Since the commencement of the present session, the society meeting room has been lighted by means of electricity. A Siemens dynamo-electric machine is employed, driven by an eight-horse-power Crossley's gas engine. Nearly the whole cost of these was defrayed by subscriptions from a few past and present members of the society's council. The lamps used are those of Edison, and there are at present fifty of them in the room. The chandeliers now in use have been lent by Messrs. Verity, who are constructing chandeliers to be permanently fitted, now that the number of lights to be used has been decided upon. Temporary fittings have been put up in the council room, and the result having been proved satisfactory, it is in contemplation to arrange for the lighting by electricity of this and other parts of the building.

BRADFORD TECHNICAL EXHIBITION, 1882.—This exhibition, which was brought to a close last week, has been lit up since its commencement by the Yorkshire Brush Electric Light and Power Company (Limited), of Leeds, who have been awarded a gold medal for their exhibit of electrical apparatus at the above place.

ELECTRIC LIGHTING.—We learn from Mr. Magnus Volk that the new Town Hall, West Brighton, which is to be opened on the 13th inst., is to be illuminated by means of Swan's incandescence electric lamps. The Pavilion committee of the Brighton Town Council have also decided to light that building on the "Swan" system by electricity, and both operations will be carried out by Mr. Volk. The number of lamps required will be considerable, and we wish the undertaking every success.

THE authorities of Brighton are generally ready to take almost any measures which may benefit the town, and we may therefore expect to hear of many installations of incandescence electric lighting in this fashionable watering place, more especially as the introduction of the Ferranti machine would so materially reduce first cost.

WE understand the Yorkshire Brush Electric Light and Power Company (Limited), of 1, East Parade, Leeds, has secured a contract for the lighting up of the market-place ar[illegible]al streets of Dewsbury, Yorkshire, during the Christmas holidays, and this company is now [illegible] machines and erecting wires and camps for [illegible] sixteen 2,000 candle-power Brush arc lights.

APPLICATION from the Brush Electric Light and Power Company and the Carbon Electric Light Company, for lighting the streets of Dundee, were produced at the meeting of the Watching and Lighting Committee, held on Tuesday, and remitted to a sub-committee.

ON Saturday last, by permission of the Union Steamship Company of New Zealand, an exhibition of the Edison incandescent light was given on board the s.s. *Tarawera* at Albert Harbour, Greenock. A private view was held during the afternoon, at which a large and influential company was present, and in the evening the vessel was thrown open to the public at a small charge per head, the proceeds to go to the Greenock Infirmary. Among those present in the afternoon were Mr. James T. Bottomley, F.R.S.E.; Captain Watson, of the Cunard Company (in the absence of Mr. John Burns, of Wemyss Castle); Captain Liest, of the North German Lloyd's; Mr. Napier, shipbuilder; Mr. Hugh Brown, director of the Caledonian Railway Company; Captain Williamson, of the river steamer *Ivanhoe;* Mr. John Darling, superintendent of the Union Steamship Company; Mr. Bennet, Mr. Hislop, gas manager, Paisley; the Messrs. Henderson, shipbuilders; Mr. John Scott, shipbuilder, Greenock; Commander Hereford, of H.M.S. *Warrior;* Mr. Brock, of Messrs. Denny & Co., the builders of the *Tarawera;* Mr. Alexander, of the Guion Line; Mr. F. W. Allan, of the Union Steamship Company of Southampton; Mr. Charles T. Grant, Glasgow agent for the Edison Electric Light Company; the provosts and magistrates of Glasgow, Greenock, and other neighbouring burghs, &c.

The *Tarawera* is one of the latest vessels built by Messrs. Denny & Co., Dumbarton, for the Union Company of New Zealand. She is the first ship in this country lighted by the Edison Company, who have appointed Mr. C. T. Grant, 160, Hope Street, Glasgow, their agent. The company present expressed great satisfaction with the results of the system. Every part of the vessel from stem to stern was lighted by the electric lamps, which number 150 in all. Each stateroom has one lamp enclosed in an opaque globe, which makes the light very pleasant, though without the opaque glass the light is by no means unpleasant to the eye, but steady, brilliant, and mellow. In the saloon the lights are enclosed in large handsome opaque globes, while in addition the whole ship is fitted with the ordinary oil lamps ready for use. The motive-power is supplied by a Brotherhood three cylinder direct-acting engine, working at a speed of 470 revolutions per minute, and driving the 150-light dynamo machine direct. The normal speed is 850 revolutions per minute, but to suit the circumstances of the case the electricians of the Edison Company have made certain modifications, which enable it to be run at a lower speed without lessening its supplying power. The engine is placed near the steam-engines for driving the propeller of the vessel. The space taken up by the dynamo and engine, which are coupled together on the same bed flat, is nine feet by two feet six inches. The lamps throughout the ship are each 16 candle-power actual, and those in the staterooms are provided with a tap by which they can be turned off or on. The wiring throughout the vessel is done with copper wire, covered with four separate coatings of insulating material; while at every point where wires branch off to supply lamps or groups of lamps a safety fuse is inserted. The tunnel-way of the shaft, which is lighted by only two lamps, gave immense satisfaction to many ship captains and others, as the light was perfect in what is usually one of the darkest and most difficult places of the ship. All on board were highly pleased with the system, including several gas engineers of the highest eminence. We are informed that Captain Williamson, of the *Ivanhoe*, has decided to light his steamer during the evening cruises next summer with the electric light. Notwithstanding the heavy rain on Saturday evening large numbers of people visited the ship, all seeming to be much interested in the practical application of the mode of lighting.

MR. FOWLER laid before the Lambeth Vestry the report of the delegates appointed to attend the electric lighting conference held recently in the Camberwell V[illegible] Hall. [illegible] said he regretted that such an important mat[illegible] as ele[illegible] lighting was thrown upon the shoulders of the [illegible] rities in the manner it was by the Act of Parlian[illegible] he was satisfied that the electric light had no[illegible]

sufficient trial to make it a form of illumination which the vestry or any other public body could deal with. There had then been received at the Vestry Hall plans of one of the companies which proposed to bring the electric light into Lambeth, and it appeared from these that the light would be laid on in the main roads from Westminster, Waterloo, and Vauxhall, right through to the upper part of Brixton Hill. Now, considering that in the parish of St. James', Westminster, which had a comparatively small area, it was calculated that the expense of the electric light would amount to £144,000, they could approximately estimate what it would cost to introduce all the necessary appliances into so extensive a parish as Lambeth. The expense would simply be enormous. The powers given to the electric lighting companies were, in fact, so extensive that it would be difficult to say to what extent they would, if carried out, affect the roads and sewers of the parish. The conclusion arrived at by the conference held in Camberwell was that the local authorities should be advised to apply for licences, so as to keep the power in their own hands. He concluded by moving that the necessary steps be taken by the clerk to call a special meeting at which the question of applying to the Board of Trade would be considered. The special meeting will probably be called for early in January.

A LETTER was received by the Newington Vestry from St. George's, Hanover Square, forwarding a report on the Electric Lighting Act adopted by that vestry. They declined to give any consent to or support any application for provisional orders from the companies. At the same time they were not prepared to apply for a licence themselves.

A LETTER was also received from the Metropolitan Brush Company announcing their intention to apply for a licence to supply St. Mary, Newington, St. George the Martyr, Southwark, and St. Saviour's, Southwark. They sought to lay wires along the Walworth Road, Newington Butts, Great Dover Street, Blackman Street, Newington Causeway, Kennington Park Road, and elsewhere. They also sought to obtain the site of Horsemonger Lane Gaol and other sites as stations. On the motion of Mr. Marsland it was agreed that all the notices and plans on this subject be referred to the Works Committee for consideration and report.

IN the Court of Common Council, last week, Mr. Deputy McGeorge asked the chairman of the Commissioners of Sewers what was the extent of the area of the City under the control of the Commission already lit by electricity, and if they proposed to extend the same? Also whether the question of lighting the whole City by electricity had been considered by the Commission recently, and if so did the Commissioners propose to do the work themselves, or was it proposed to invite companies to undertake the work under the powers of a provisional order?

Mr. Felton (chairman of the Commissioners of Sewers) could not give the exact area of the City that was at the present time lighted with the electric light, but he gave the names of the streets. With regard to the second question he might say that he believed the intention of the Commission was to have the whole City lighted by the electric light. The whole matter was now under consideration, and would be brought up at the next meeting of the Commission, whether the companies should be allowed to treat or compete for the lighting, or whether the City would take it up itself.

Later on, Mr. Felton said, in answer to Mr. Deputy Fry, that the time had gone by for them to apply for an order under the Electric Lighting Act, but they could apply for a licence under that Act at any time. The difference between the provisional order and the licence was this, the provisional order would be for twenty-one or more years, subject to the approval of Parliament, while the licence would be for a term not exceeding seven years.

AT a meeting to consider the question of qualification of members of the Commission of Sewers, Mr. Stoneham moved, "That the following be a standing order of this Court, viz.: That no member of this Court who shall be a [illegible]hareholder in, or concerned for, or in any way pecuniarily [illegible]rested in any lighting company applying for permission [illegible]ght, or actually lighting, the City of London, shall be [illegible]ted or continue a member of the Commission of [illegible] Mr. H. Gover seconded the motion. He was [illegible]

astonished to find that in the Commission of Sewers a large number of gentlemen interested in the electric light voted in a division on this important subject, and carried a resolution as he thought adverse to the interests of the Corporation by a majority of one. If this question of the electric light was being decided by interestsd persons it was a great shame, and should be put a stop to. Mr. Fricker moved, as an amendment, "That no member of this Court who shall be a shareholder in, or concerned for, or in any way pecuniarily interested in any lighting company applying for permission to light, or actually lighting the City of London, shall vote upon any question before the Commission of Sewers affecting the lighting of the City, or take any part in the discussion of any such question."

Mr. Fricker's amendment was afterwards agreed to.

Apropos of this the *City Press* says:—"Is not Mr. Stoneham's motion in the Court of Common Council, with reference to members of the Commission of Sewers being shareholders in electric lighting companies, unnecessary? No member can vote upon a question in which he is pecuniarily interested, and what more can be wanted?"

A DEPUTATION, representing the principal corporations of England and Scotland, had an interview on Tuesday last with Mr. Chamberlain at the Board of Trade, on the subject of the Electric Lighting Bill, to urge upon him the importance of making the use of the electric light permissive, and not obligatory. Mr. Arnold Morley, M.P., introduced the deputation.

Mr. Littler, Q.C., stated the views of the deputation, and Mr. Chamberlain made a long reply. The matter seems to be very well commented upon by the *Globe*, in a short article which reads as follows:—

"A bold attempt was made by some of the most important city corporations of England to protect themselves against the threatened introduction of electric lighting into the districts administered by them. Their application to the Board of Trade had a very harmless appearance, as it professed only to ask that the use of the electric light should be made in each case permissive and not obligatory upon the applicants. If it were possible to accept this as a true description of the privilege which the corporations wish for, no one would be so hard-hearted as to wish that the request should fail. There is no doubt that at this time a great disposition to threaten the local authorities in large towns with an invasion of the rights they have so long enjoyed by substituting for the old-fashioned system of gas lighting, over which these corporations often exercise complete control, an electric scheme to be carried out by a wholly independent body. The corporations will be put to much trouble and expense in combating such schemes, even where these are worthless or of doubtful utility; and they are anxious to devise some plan by which they will be saved from these inconveniences. But the device they have hit upon, and which the deputation was yesterday charged with advocating before Mr. Chamberlain, is one of a kind that cannot be accepted in blind faith by the public, if it is at all desirous of allowing the new light to have a fair trial. The proposal is that corporations should themselves acquire powers to apply the electric light, but without being at the same time compelled in the usual way to apply it without delay. They would by this means procure for themselves the right to exclude all other applicants, and if by any chance their desire to introduce the new light should die a natural death after the order was safely obtained, there would be no means whatever of introducing it, however much desired by the public. It is not surprising that the Board of Trade should hesitate before acceding to such a request. The corporations may call it a permissive scheme which they advocate, but the name is not well chosen. For corporations, as well as other bodies, are already 'permitted' to apply for lighting powers if they choose. What they now want is, not permission, but a right to exclude other applicants by obtaining for themselves a privilege which they have, to say the least of it, no burning desire to exercise immediately."

On Saturday last, at the meeting of the Electric Lighting Committee of the Corporation of Leeds, the following important correspondence between the Town Clerk and the Board of Trade was read:—

Town Hall, Leeds, *November 25th*, 1882.

SIR,—I have received the instructions of the Electric Lighting Committee of the Leeds Corporation to communicate with you with

regard to the terms of the proposed provisional order which the Corporation is about to apply for under the Electric Lighting Act, 1882. Will you permit me, in the first instance, to respectfully lay before you the position which the Corporation of Leeds has taken with regard to the electric lighting question?

So far back as last May the Corporation appointed a committee to make inquiries with regard to the practicability of supplying Leeds with the electric light, and that committee, after making considerable investigations in London and elsewhere, published a careful report upon the subject.

Again, immediately upon the Act of last Session becoming law, the Corporation appointed an Electric Lighting Committee (as contradistinguished from the Gas Committee) to further consider the question of applying the system of electric lighting to this borough. There was then, and has been all along, a *bonâ fide* desire on the part of the Corporation of Leeds to give the new light a fair trial, and, if it should be found feasible, to utilise it in some parts of, if not throughout, the borough.

I was simply stating, in the evidence which I gave before the Select Committee on the Electric Lighting Bill, what I knew to be the feeling of the members of the Corporation of Leeds, when I said that there was certainly no desire on their part to obstruct the electric light, but, on the contrary, a determination to adopt it if it should prove to be a better light at as cheap a rate as gas, and that notwithstanding that the corporation had invested nearly a million of money in a large gas undertaking. I also ventured to point out to the Select Committee that the Corporation of Leeds having given the gas consumer the benefit of the profit arising out of the gas system, and thus having reduced the price of gas to 1s. 10d. per thousand cubic feet, had done nothing as a lighting authority to disentitle it to the confidence of Parliament or of the Board of Trade.

The action of this Corporation has, since the Electric Lighting Act came into force, been most carefully and anxiously considered by the Electric Lighting Committee, and that committee has felt justified in recommending the Town Council to apply for a provisional order with a view to the matter being dealt with by the Corporation itself, as the local authority. The question now arises as to what conditions the Corporation is to be placed under in this proposed provisional order.

It has been stated that the Board of Trade will insist upon a clause being inserted in all orders providing that the duty to supply the electric light shall be forthwith made obligatory upon corporations. I respectfully submit, on behalf of the Corporation of Leeds, that the clause which we are entitled to ask to be inserted in our order should be of a permissive and not of a compulsory character—with a proviso, if the Board of Trade should think fit, giving power to that body to revoke the order if no *bonâ fide* attempt were made within a reasonable time to carry out the spirit of such order.

We venture to assert that what we have done in the past with regard to the question of lighting is a sufficient earnest and guarantee that, so soon as the new light can be made a commercial success, advantage will be immediately taken by the Corporation to give the benefit of it to the ratepayers of this town.

To-day is the last day for the insertion of advertisements by companies intending to apply for provisional orders, and no company has inserted an advertisement indicating that it intends to apply for an order with regard to Leeds. I wish, however, that it should be distinctly understood that no advantage will be taken of this, and that it will not in any way interfere with the proposed application of the Corpo.ation.

I may say that the Corporation is at present in communication with several electric lighting companies with a view to receiving tenders from such companies for the lighting of the town hall, public offices, and other contiguous buildings, and that it is the intention of the Corporation to have the buildings referred to lighted with the electric light immediately.

The Electric Lighting Committee, however, is anxious, with a view to its own guidance, to ascertain the feeling of the Board of Trade with regard to the question of compulsory supply.

It is unwilling to believe that, in a case such as I have ventured to place before you in this letter, the Board of Trade will insist upon a clause being inserted in the order the effect of which will be to involve an immediate large outlay of capital—the money of the ratepayers—at a time when no one can with certainty predict that such expenditure will be justifiable.

I am, Sir, your obedient servant,
GEORGE W. MORRISON, Town Clerk.

The Right-Hon. Joseph Chamberlain, M.P., President of the Board of Trade, Whitehall, London, S.W.

Board of Trade (Railway Department), London, S.W.,
November 30th, 1882.

The Electric Lighting Act, 1882.

SIR,—I am directed by the Board of Trade to acknowledge the receipt of your letter to the President of the 25th inst., in which, by instruction of the Electric Lighting Committee of the Leeds Corporation, you state their wish to be informed of the views of this Board upon the question of the conditions they may require to be inserted in the provisional order which the Corporation are about to apply for under the provisions of the above-mentioned Act.

The Board of Trade desire in the first place to point out that it would be premature before they have the proposed order before them to attempt to give an opinion upon the scheme, or to foretell the form or substance of conditions which they may find it necessary to introduce therein.

But the Board of Trade have no hesitation in saying that in their [illegible] was the intention of Parliament that the schemes to be [illegible] by licences or provisional orders under the Act should be [illegible]emes for definite undertakings, and not schemes containing general powers authorising a corporation or a company to light all or any portion of a town if, when, and as they might in their discretion think it desirable to do so. It would further, in their opinion, be clearly contrary to the intention of Parliament to sanction a scheme which merely enables the promoters to appropriate an area of supply to the exclusion of other applicants.

The exact amount of definition necessary in the order, the precise time within which the compulsory supply shall be given, in what cases, at what times, and under what conditions the proposed works must be executed, are matters which can only be determined when the schemes are actually before the Board of Trade. But about the principles above indicated, the Board of Trade have no doubt, and they will feel bound to act upon them, whether in dealing with the case of a corporation or a company.

I am, Sir, your obedient servant,
HENRY G. CALCRAFT.

The Town Clerk, Town Hall, Leeds.

The Leeds Committee subsequently passed this resolution:—"That the Provisional Order be proceeded with, and that the Town Clerk represent the Corporation of Leeds at a meeting to be held in London on Tuesday, the 5th inst., of representatives of the various corporations which are promoting Provisional Orders."

MEDAL COMMEMORATIVE OF THE EXPOSITION D'ELECTRICITÉ OF PARIS IN 1881.—M. le Ministre des Postes et Télégraphes is now distributing to all persons who participated in the Exposition Internationale d'Electricité of Paris, in 1881, a commemorative medal of which we hope to reproduce the fac-simile in our next number.

SOCIÉTÉ FRANÇAISE DE PHYSIQUE.—On the occasion of the November 17th sitting, M. Cabanellas gave his theoretical researches upon the transmission of power by electricity. We need not remark upon it here, since the work of M. Cabanellas was published in the ELECTRICAL REVIEW for November 25th. The sitting of the 1st December, which did not bring forth an electrical communication, was, however, marked by an incident to be regretted from all points of view. The Société Française de Physique sends to all its members, three or four days before each sitting, a small circular which contains the order of the day of the next sitting and the *résumé* of the communications made in the preceding sitting. M. Marcel Deprez imagining, rightly or wrongly, that the *résumé* relating to the discussions which followed the communication of M. Cabanellas, did not represent faithfully the character of the sitting of the 17th November, at which, however, he was not present, thought proper to resign his membership of the Société. This resignation was accepted, but we must regret the deed, resulting from a moment of pique, which deprives the Société of one of its most valuable members and seems to put under suspicion the high and indisputable impartiality of the officers of the Société. In our opinion, a simple verbal rectification would have been quite sufficient.

THE INCANDESCENT LAMP WITH MAGNETIC SUPER-EXCITATION OF M. CLORIS BAUDET, OF PARIS.—John Banting Rogers is surpassed, the man with the "multiple binding screw" is no more than an inventor of the fifteenth order by the side of the designer of the wonderful lamp of which we cannot help giving a complete description to our readers. It will be seen that Edison has not yet patented everything, and that the field still remains open for further progress. The origin of this invention is indeed curious. The author, in a small pamphlet devoted to his ideas, reminds us of all the inconveniences with incandescent lamps (platinum or carbon), and informs us that to meet all these inconveniences was not an easy matter, and that all his attempts fell into the same groove. We will quote here his own words:—

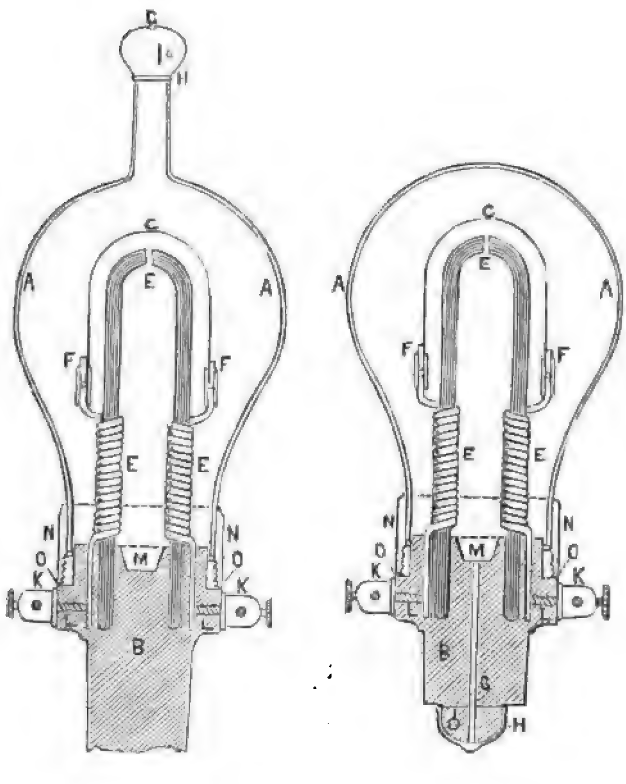
"At last, after seeking the desideratum without success, I had abandoned it when, in making some experiments upon platinum, I observed that when this wire is heated to redness by the passage of an electric current, if one presents to it the poles of an electro-magnet actuated by a powerful current one sees the wire, opposite the magnetic core, from being red become white, without this degree of incandescence producing fusion of the metal. This discovery seeming very remarkable to me (we can scarcely believe it), I sought to utilise it by employing in the lamp an electro-magnet, which, by reason of its disposition parallel to the carbon, and by its influence upon it, produces a wh[illegible]

when, ***without this magnetic superexcitation***, it would only be red."

This is clear, is it not?

Following this are some considerations of the so-called practical vacuum in the lamps, a vacuum which, according to the inventor, is *unimportant*, and a hint at the end which is of inestimable value—"This lamp will not be sold for some months; its price will not be high; meanwhile we are ready to utilise *those which are actually in the trade*" (*sic*). The inventor is not a bad man of business.

In order not to be accused of exaggeration, we reproduce here the inventor's drawings and the written description of the lamp, copying the prospectus, which is in our hands:—



A, glass globe containing the system;

B, insulating material, supporting the whole of the system of the lamp;

C, carbon of the lamp, fixed by its extremities at F to the rheophores, E, composing the electro-magnets and the wires leading to the generator, by means of the terminals, K. The electro-magnet may be replaced by a permanent magnet;

E, electro-magnet;

F, mode of attachment of the carbon by wedges;

G, aperture for the escape of the expanded air contained in the globe;

H, india-rubber capsule forming a valve at I at the escape aperture (this valve may be arranged in any suitable manner);

K, terminals insuring contacts at L for the passage of the current from the interior to the exterior of the lamp;

M, receptacle intended to contain any absorbent materials considered necessary;

N, metallic ring cemented to the globe into which the system, B, is screwed at O, resting upon a leathern washer to insure hermetical sealing;

(N.B.—One could, nevertheless, if one considered it necessary, make the vacuum by the escape aperture or by an opening made in the cylinder, B, with a valve *ad hoc*.

The ideas of the inventor on electric measurements are also quite original, and he derides the ohm, volt, &c. All this is replaced by a simple galvanometer with two wires; you place the two wires successively upon the element of the battery to be tested, you read the deviations in degrees. . . . . and that is all. The element gives upon the fine wire 40° Cloris Baudet of the *force of electric tension* (*sic*) and 24° Cloris Baudet of quantity, you then know perfectly its value. What simplicity! And this is printed in France in 1882, and there will be found a number of imbeciles to buy a *standard* Cloris Baudet galvanometer.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The Annual General Meeting of the Society will be held at 8 p.m. on Thursday, the 14th December. The following paper will be read:—"The Application and Extension of Telephonic Communication in Japan." By Thomas J. Larkin, member.

THEATRICAL PERFORMANCES AND THE ELECTRIC LIGHT.—The *Figaro* says that "the incandescent lamps worn in the hair of four of the Peris at the Savoy on the opening night did not produce the happiest effect. The light dazzled the eyes and gave rise to an uncomfortable suspicion of possible danger. For, although the wires are doubtless completely insulated, yet a fracture or a rub would imply instant death to the unhappy lady who wears the lamp. It is, doubtful, after all, whether the game is worth the (incandescent) candle." If the author of the above extract is not making fun, we would advise him to investigate the danger by personal experience before writing again on the subject. Does not the writer know that "electricity is life?"

THE GILCHRIST LECTURES.—Dr. Lant Carpenter delivered the first of a course of lectures in connection with the Gilchrist Educational Trust, at Forfar, on Monday evening, and on Tuesday he repeated it at Arbroath. The subject was "The Production and Storage of Electrical Energy." At both meetings the attendance was very large.

PERSONAL.—The Jablochkoff Electric Light and Power Company, Limited, has appointed Mr. Francis R. Reeves secretary and general manager to the company.

TO TELEPHONE PATENT INFRINGERS.—The *Edinburgh Courant* says: "The United Telephone Company have circulated a warning to any one selling or using without their licence, any form of telephone covered by the patents in the company's possession. Appended to the formal declaration that proceedings will be taken in case of any infringements to these patents are short *résumés* of cases decided in favour of the company, the chief being that against Mr. Alexander MacLean, of Edinburgh, in which an important judgment was pronounced by Lord M'Laren.

ELECTRICAL POWER STORAGE COMPANY (LIMITED).—We are informed that the Electrical Power Storage Company (Limited) will, from the 1st January next, be prepared to receive application for the supply of electrical accumulators for lighting or motive power, or for the undertaking of complete installations of electric lighting of districts, private houses and establishments, railway trains or ships.

NEW COMPANIES REGISTERED.

NORTH WOOLWICH TELEGRAPH WORKS COMPANY (LIMITED).—Capital £100,000, in £10 shares. Objects: To carry on business as electricians, telegraph engineers, and contractors, manufacturers of electric appliances, and producers of light, heat, and power by electricity, magnetism, and galvanism. Signatories (with one share each): A. E. Tylor and W. L. Bright, 5, East India Avenue; J. B. Ball, 1, Gresham Buildings; C. O. Newman, Yeovil; A. T. Atchison, C.E., 38, Parliament Street; C. E. Harrison, Rochampton; F. W. Smith, 155, Fenchurch Street. The signatories are to appoint the first directors. Qualification: Five shares. Registered 29th ult. by Gedge, Kirby, Millet, and Morse, 5, Lime Street Square.

NORTH ATLANTIC CABLE COMPANY (LIMITED).—Capital £600,000, in £10 shares. Objects: To effect telegraph communication between Europe and America by submarine and other lines. Signatories (with one share each): James Gordon Bennett, New York; W. A. Simpson (manager), Hendon; A. T. West, 44, Mount Pleasant Road, Lewisham; T. W. Powell, 1, Drapers' Gardens; A. H. Clark, 17, Stratford Place; E. Heseltine, 1, Drapers' Gardens; W. Huyshe, 46, Fleet Street. The signatories are to appoint the first directors and are themselves to act in the meantime. Qualification: Shares or stock to the nominal value of £1,000. Mr. Arthur Hamilton Clark is appointed managing director at a salary of £3,000 per annum. Registered 2nd inst. by Jackson and Prince, 64, Cannon Street.

NEW PATENTS—1882.

5669. "Apparatus for measuring or indicating electric currents." J. BLYTH. Dated November 29.

5673. "Processes of construction and the construction of electric wires and cables." A. J. BOULT. (Communicated by R. S. Waring.) Dated November 29. (*Complete.*)

5677. "Mechanism for regulating the production of electricity." H. WILDE. Dated November 29.

5693. "Improved means of and apparatus for telegraphing into and from railway trains in motion." W. L. HUNT. (Communicated by R. M. Hunter.) Dated November 30.

5695. "Process of and apparatus for generating and measuring electricity." V. W. BLANCHARD. Dated November 30. (*Complete.*)

5702. "Telephonic receivers." T. TORREY. Dated November 30.

5711. "Manufacture of conductors for electric currents." W. R. LAKE. (Communicated by F. F. Fitch.) Dated November 30.

5715. "Manufacture of magnetic and ventilating wearing apparel for the prevention or cure of disease." W. R. LAKE. (Communicated by S. A. B. Wilson.) Dated November 30.

5742. "Electric and magnetic apparatus for telephonic or other purposes." S. P. THOMPSON. Dated December 1.

5744. "Apparatus or appliances for automatically regulating electric currents." J. T. KING. (Communicated by J. R. Finney.) Dated December 2.

5747. "Generating and utilising electric energy." A. J. BOULT. (Communicated by B. Faquant.) Dated December 2.

5754. "Electrical switch for electrical lamps and other purposes." G. W. BAYLEY. Dated December 2.

5757. "Manufacture and preservation of insulated electric conductors and compounds that may be used for the same and for other purposes." E. T. TRUMAN. Dated December 2.

5767. "Accumulators or secondary batteries. W. A. BARLOW. (Communicated by L. Encausse and Canésie.) Dated December 4.

5769. "Improvements in electro-magnets and in electro-dynamo machines constructed therewith." E. G. BREWER. (Communicated by A. L. Bonnefils.) Dated December 4.

5779. "Electric lamps and switches therefor." A. FERGUSSON. Dated December 5.

5783. "Magneto and dynamo-electric machines." W. A. BARLOW. (Communicated by W. E. Fein.) Dated December 5.

5796. "Electric lamps and lighting apparatus." W. R. LAKE. (Communicated by R. H. Mather.) Dated December 5.

5797. "Primary voltaic batteries." T. J. JONES. Dated December 5.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1794. "Apparatus for generating currents of electricity." E. L. VOICE. Dated April 14. 10d. It is well known that when a core of soft iron coiled with wire is made to approach the pole of a magnet, currents of electricity are generated in the wire in an inverse direction to those which circulate, or are supposed to circulate—according to Ampère's hypothesis—around the magnet, and these currents have a mutual repulsion, consequently a force is set up tending to repel the coil from the magnet. When, however, the coil recedes from the magnet, direct currents, or currents circulating in the same direction as those of the magnet, are generated. The production of these alternately opposite currents offers a great resistance to the revolving armature in existing machines for the mechanical generation of electricity. It is also well known that if a number of permanent magnets be placed side by side with their like poles adjoining, thereby forming a battery of magnets with a plane surface, and if a piece of soft iron coiled with wire constituting a small bobbin of such dimensions that the length of the polar field of the magnets is practically infinite with regard to the bobbin be moved so as to cut the lines of force in the magnetic field, currents of electricity will be generated in the wire, the direction of which currents will depend on the direction of the movement of the bobbin. These currents, however, are of little intensity. Now, in machines according to the new invention, a pole of the opposite name to the pole to which the bobbin as just referred to is already subjected is brought into contact with each end of the bobbin and moved with the bobbin, and in this way currents are generated of considerable intensity without change of polarity of the core of the bobbin, the core itself forming an extension of, and joining, two poles of like name. In carrying out the invention in magneto-electric and dynamo-electric machines, the inventor arranges a permanent or electro-magnet in such a manner that the armature or armatures may be made to be of opposite polarity to those magnets which surround it or them, and before whose poles it or they, is, or are, made to revolve. Referring to the accompanying drawings, in which like letters of reference indicate similar parts, and which are appended of illustration, fig. 1 is a diagramatic view explanatory of ral principle of the invention; N, S, N, S, are a number of bar magnets laid side by side, and serving to create a magnetic field which the coil (in this case shown above the south field) never leaves. This coil is wound upon an iron bobbin in contact with the two north poles of two other bar magnets. When the coil with its accompanying two magnets is moved so as to cut the lines of force, a current is

FIG. 1

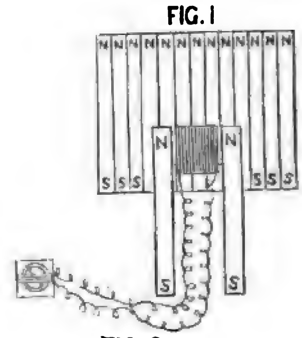
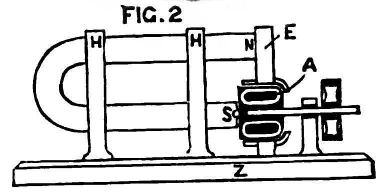


FIG. 2



generated in the convolutions which may be demonstrated by a galvanometer included in the circuit as shown. Fig. 2 shows a side elevation partly in section, and fig. 3 a cross section of one form of apparatus according to the invention, N, S, is a horseshoe magnet firmly fixed by standards, H, H, to the base, Z. E is an iron plate

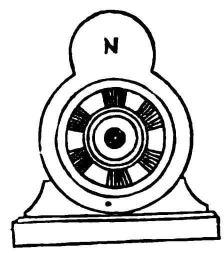


FIG. 3

FIG. 4

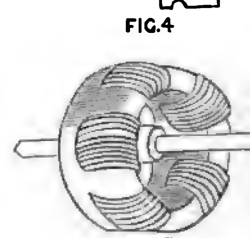


FIG. 5

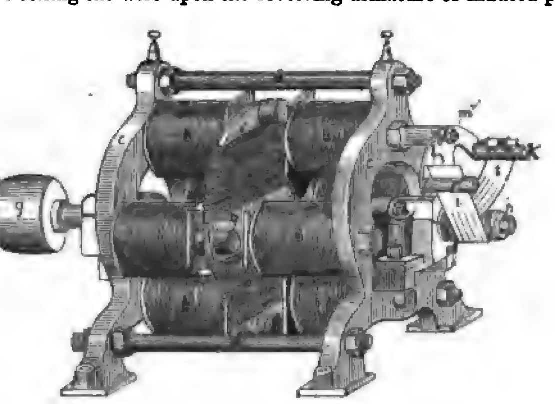
forming a polar extension of one pole. A is an armature, the shape of which, when denuded of wire, is seen at fig. 4. Fig. 5 shows the method of coiling which may be adopted. The armature by induction forms a polar extension of the pole, S, thereby causing the core of the armature to be of S polarity, and of opposite name to the plate or polar extension, N, or *vice versa*.

1867. "Electric arc lamps." A. B. BROWN. Dated April 1[illegible]. 6d. Has for its object, by a combination of simple automatic contrivances to obtain on the one hand a feed or progressive movement of the carbon or carbons of an electric arc lamp very closely according with the actual gradual consumption of the carbons, and on the other hand to secure the speedy readjustment of the carbons to the desired arc distance apart whenever they, from any cause, become so far separated that the current cannot pass. In carrying out the invention, the feed movement of the carbon or carbons is effected by the weight or pressure of a piston and parts attached thereto, the piston working in a cylinder and pressing on a liquid which has egress only through a small port, formed in a port face having on it a small slide valve, the position of which regulates the egress of the liquid and consequent movement of the carbon or carbons. The valve is connected to the iron core of a solenoid and to an adjustable spring, the current passing through the solenoid coils being that which forms the luminous arc, and tending to move the core so as to close the valve in proportion as the curr[illegible] is stronger, whilst the spring is arranged to act opposi[illegible] to open the valve whenever the current becomes w[illegible] or a part moving therewith, carries the carbon i[illegible] suitable holder, in which holder the carbon is ca[illegible]

current, being led to it through a flexible coil or spiral. The carbon is ordinarily held in its holder by a lever acting on it with an eccentric or other suitable gripping device which only acts when the lever is being raised or held up. When the current is passing all right, the gripping lever is held up either by the core of the solenoid which regulates the progressive or feed movement, or by a separate solenoid or electro-magnet; but when the carbons become so far separated that the current cannot pass, the gripping lever becomes released, and allows the upper carbon to descend into contact with the lower one. The current then passes again, and the solenoid or electro-magnet raises the gripping lever again, and the gripping lever in rising, lifts the upper carbon the proper distance for the pre-determined length of arc. The gripping lever is proportioned and arranged to give the proper amount of lift for the required arc, and its descent may be regulated by an adjustable stop.

1875. "Secondary batteries." D. G. FitzGerald, C. H. W. Biggs, and W. W. Beaumont. Dated April 19. 6d. According to the present invention, the inventors deposit lead electrolytically either within moulds or dies in which the material is to be compressed, or in other moulds of similar form, or they deposit in bulk so as to obtain a mass of finely divided crystalline lead, such mass constituting the material from which porous plates or cakes flat or otherwise may be obtained by compression.

1878. "Dynamo-electric machines." J. H. Johnson. (A communication from abroad by J. M. A. Gérard-Lescuyer, of Paris.) Dated April 19. 6d. This invention relates to improvements in dynamo-electric machines, and it consists in a novel and special arrangement of the parts. The invention is based on a peculiar mode of coiling the wire upon the revolving armature or induced part



of the machine, together with a special construction and arrangement of this induced part, for the purpose of still further augmenting the electromagnetic action, which is considerably increased by the said peculiar mode of winding the wire upon the armature; and another distinguishing feature of the invention consists in the novel arrangement of the commutator. A general view of the machine is shown by the figure.

CITY NOTES, REPORTS, MEETINGS, &c.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).

On Friday, the 1st inst., an extraordinary general meeting of the shareholders of the above-named company was held at Cannon Street Hotel, Sir James Carmichael presiding, for the purpose of considering a proposition by the Eastern Telegraph Company to purchase all the property, concessions, and undertakings of the Mediterranean Extension Telegraph Company.

In the offer, signed by the solicitor to the Eastern Company, Mr. Charles Burt, the following words occurred:—"The division of the amounts between the preferred and ordinary shareholders of your company appears to me to be a matter for your board; but taking the present market value of the shares as a basis, I propose that the amount shall be divided as follows:—

3,200 preference shares at £6 10s.	£20,800
12,000 ordinary shares at £1 12s.	19,200
	£40,000

The reserve fund would, I presume, be distributed amongst the shareholders in like proportions."

The Secretary, Mr. E. Tombs, having read the notice convening the meeting,

The Chairman said: Gentlemen, it will be in the recollection of all who were present at the last meeting of the shareholders, on the 31st August, that I then informed you that certain negotiations were opened with the Eastern Telegraph Company for the purchase of our property. I told you that these negociations were not in a state to bring before you, but that as soon as any definite proposal was made we should, before taking any further steps in the matter, or moving in any way in reference to the subject to compromise your interest, lay before you the whole question and take your opinion upon it before acting further in the matter; and it is with this object in view that a circular has been addressed to you enclosing the absolute offer of Mr. Burt, the solicitor to the Eastern Telegraph Company, and that you might yourselves form some opinion of that offer—and might meet with us and consult upon it. It would have been more pleasant to us as directors if that offer had been couched in a more liberal spirit (hear, hear). But such as it is, it is our duty to lay it before you, and to take your advice and have your opinion upon it. With regard to this meeting, of course we could not at a meeting to-day decide anything more positive more than to get the general wish of the majority of the shareholders. If you are to decide upon selling your property, then, of course, it will be necessary to call a special meeting, I believe. Our solicitor will tell me if I am wrong. Then we could go into a friendly liquidation and appoint liquidators, and then the liquidators would sell to the Eastern Telegraph Company. I believe that is the legal form of carrying out the sale. Therefore I asked you to come here to-day, and I am now most willing and shall be most anxious to answer any questions you may put as far as I can. We want to consult with you upon the best course to take (hear, hear).

Mr. W. Ford would simply like to say that he did not object to the terms proposed by the Eastern Telegraph Company, but he did strongly object as an ordinary shareholder to the proposed appropriation of the reserve fund in the manner set forth in Mr. Burt's letter. It did not come within the duty of the Eastern Company, and indeed it was beyond their duty and their province to make any suggestion as to the distribution of the reserve fund (hear, hear). That was entirely a question between the shareholders themselves.

The Chairman: Quite so.

Mr. Ford proceeded to say that in giving his assent to the terms proposed, and he trusted this meeting in giving their assent to the proposal for the purchase at the proposed price would not give their assent to the proposed appropriation of the reserve fund. That fund had been created at the expense of the ordinary shareholders, because it had been dividend kept back from them to which they would have been entitled if it had not been kept back as reserve.

The Chairman: It is certain that the distribution of the reserve is entirely a shareholders' question: you can dismiss that from your mind.

Mr. Ford said that he was glad, then, that he had ventilated the question. The meeting had been called to consider the offer proposed in Mr. Burt's letter, and that was one of the suggestions in that letter.

The Chairman: That is only a suggestion, I think, with the letter.

Captain Turner said that he should put it much more strongly. It was not a suggestion: it was an impertinence.

Mr. Burton: Will you explain to us what these preference shares are, and how they became such?

The Chairman said that the preference shares were created many years ago with the object of laying down new cables. He should say fifteen years ago. They were preference only as regarded ordinary dividends.

Captain Turner said he observed that the directors made no recommendation in this matter.

The Chairman said that the directors had made no recommendation. They wished the shareholders to consider this question themselves. He should like himself to abstain from giving any opinion as chairman of the board. The board would rather be excused from giving advice which the shareholders might afterwards think to be not advantageous. Of course he had his own opinion, but as this was a shareholders' question they ought to form their own opinion.

Captain Turner said he should very much like that the board would give an opinion, as perhaps they knew more about this matter than he did.

The Chairman: I can assure you the board do not, but as an original shareholder in this company—I paid my £10 per share—I have no hesitation in saying I do not want to part with my property at the price of the offer, but of course that is my own opinion. Other gentlemen who may have come in on much more favourable terms—who have only paid £2 or £3 a share—may think it desirable to do it. There are also the preference shareholders. We wish to carry out your wishes, but we would have you decide. We thought it right to point out the worst that could happen to you; that the Government guarantee ceases on the 4th December (the present month), and then if we go on we must rely entirely upon our own resources for our dividends. At the present moment we should not be able to pay our ordinary shareholders anything; but we could pay the preference shareholders something. There are, perhaps, prospects of getting more traffic, for the Mediterranean is a big lake, and the Eastern Company may not always hold the monopoly of that lake. Other companies may start. We have a good position in Malta; but we must not deceive ourselves. We shall have to rely upon our own resources. I do not see that we can work it more economically than we have done. We have been under Government supervision; we have had a Government officer on our board; we have worked with the greatest economy, and I do not think we can cut down much more.

In answer to a question,

The Chairman said the company had yet two Italian concessions; one good yet for seven years, and the other for nine years.

Mr. Thomas Adams said: Having heard the chairman's opinion upon the matter as a shareholder—and he thought that he (the chairman) ought to know pretty well what the resources of this company were—that the shareholders should not part with the property on the very low terms—scarcely anything for the ordinary shareholders. The offer of £1 12s. was not 32/- in reality; it was not all cash, but cash and 4 per cent. debentures; £1 12s. was 20 per cent. off that. Would it not be better to consider if something better could not be done, rather than part with the property in that way? He thought the board had an offer some time ago.

The Chairman: This is the first *definite* offer we have had.

Mr. Adams said he thought the board had an offer of some kind two years ago. Debenture stock was not of much value. If it had been cash, it might have been worth 20 per cent. more. He thought the offer not worth much; it was a mere speculative value. Some other company might be got up next week and give them better value

for their property. This debenture stock was not like debenture stock in land; if they had a war, and could not get at their "rope," what would be the worth of their debenture stock then? Perhaps they would give them some idea as to how far the proprietors had yet given their opinion upon it. He did not want to say very much on the proposal, either one way or the other. It seemed to be a very miserable offer. He thought the preference holders would at all events get more than £6 10s. per share in the long run.

The Chairman: £6 10s. is the selling price.

Mr. Adams asked if it would not earn more than that for the preference shareholders to begin with.

Chairman: Yes; I think it would.

The Secretary said that the earnings last year would have given the preference shareholders 5 per cent.

Mr. Adams said he had no doubt that the preference shareholders would prefer that to the £6 10s. at 4 per cent.

A Shareholder asked how many proxies the directors held?

The Chairman said they had not got in so many as they ought to have. In proxies there was not a quarter of the capital of the company represented. But of those received, the greatest number were in favour of the proposal. There were 83 in favour, 18 against, and 21 shareholders had sent their proxies to the directors requesting them to vote as they thought best. That was an unfair responsibility to put upon them. They did not wish to bear that responsibility; they simply asked every one to vote for themselves. In reply to a further inquiry, the Chairman said that 693 shares were represented by the proxies of preference shareholders.

Mr. Vears said that the circular issued looked as though it carried with it the sanction, or implied sanction, of the chairman and the directors ("No, no," from the board). No document could be strictly neutral, and when it came from headquarters it tended to form a decision. He was utterly surprised at the paucity of expression of opinion at that meeting. They ought to have some remarks from the board indicating their opinion. For his part he was neither for accepting nor rejecting the offer. He would go home splendidly satisfied if forty out of fifty present were for it. He would ask the Eastern Company whether they were doing as they would be done by when they came with the market at its lowest and offered the lowest price? Surely they could put a little pluck and spirit into the matter. He believed the Eastern debentures were now something like 106.

The Chairman said there were no shares issued yet; it was a new issue.

Mr. Nicholls suggested that the meeting be adjourned, and that two ordinary and one preference shareholder be appointed to form a committee to confer with the directors.

Mr. J. L. Cuthbertson said that as an original and not a preference shareholder, nor a trafficker in the shares of this company from its commencement, he wished to ask, and he hoped the directors would not take offence at the question, whether they were directly or indirectly connected with the Eastern Company. (The Board: "No.") A question had been raised as to the preference shares. The preference shareholders had received a large dividend, and he thought the difference in the proposed sums, as set down, between the preference and the original shareholders seemed preposterous. He did not see himself why some sort of arrangement should not be made for this company to continue to go on. If the preference shareholders were to meet the original shareholders in a fair and equitable manner, the original shareholders might, with the reserve fund, and with economical management on the part of the board, go on as formerly. They might keep the company going and pay the preference shareholders something, so that eventually the company *might* assume an important position, or amalgamate with another company. He did not like to accept about £1 3s. or £1 4s. and about $\frac{5}{8}$ per cent. for his money; he would rather lose the lot almost. He did not think they ought, as shareholders either original or preference, to accept the offer in its present form. If a shareholder had purchased his share at something like £2, it placed him in a very different position from the man who had paid £10 for his share. The original shareholders ought to be shown some little consideration. The company had not really earned anything to pay the preference shareholders one penny according to the last six months' earnings. Under these circumstances it would be well to have the sense of the shareholders as to whether it would be well to go on with the company. They looked upon the officers of the company to make some little sacrifice as they had to do themselves. The question of salaries, for instance, might be guided by results.

Captain Turner said he should like to make one more appeal to the chairman and the board to give the shareholders their opinion and advice. He thought it was their business to give the shareholders any facts of the case. He knew many cases in which that had been done.

Sir Ashley Ponsonby (a director) remarked that he thought it was a difficult matter to give an opinion upon the matter, owing to the different prices paid by various gentlemen for their shares. To those who were large holders and had paid large sums for their shares the board's individual recommendation might be taken for what it was worth. He certainly did object, as a shareholder, to selling at the price. Being on the board he would be happy to go as the shareholders went. He was opposed to the offer, which he thought was a minimum one. This company paid the Eastern Company a large sum of money—about £7,000 a year—for messages sent over their wires. Very probably there would be other lines opening up, by means of which this company might make a profit. They had yet a seven years' concession from the Italian Government; and he could not see why they should part with their company just at this moment. He had great respect for the gentlemen of the Eastern Company, they were very sharp men of business, and not likely to part with a great deal, and this company was like a pear to drop into their mouths. Some gentlemen had remarked that the board could possibly reduce their fees, but he must warn them that the salaries of the board were now as low as they well could be. Certainly the board would do what they could in the matter to help the shareholders; but he thought they must not expect the board could do much in that direction. With reference to the earnings by last year's working, the shareholders must remember that they had repaired a cable at a cost of £1,760. They put that charge into the current half-year so that they might make the Government pay it. In future any repairs would have to be paid for out of the reserve fund. He did not wish to give any opinion as to the rights of the preference shareholders over the ordinary shareholders. If the shareholders decided to sell, they would have to do so at whatever price the courts decided.

Mr. Robinson (a director) said he wished to speak as a shareholder. He had been a proprietor in their company for a good number of years, and he had always endeavoured to carry out the proposition and urge upon the directors the necessity of amalgamation with the Eastern Company. Since he had been on the board he had endeavoured to produce that effect. He had had communication, some fifteen or sixteen months ago, with Sir James Anderson, when he stated that he would give us £2 10s. per share in cash, and give for our preference stock a debenture stock, at 3 per cent. That was submitted some time ago, but I think the opinion was that not less than £3 per share should be taken for the ordinary shares. There was no gentleman present who was a holder of preference shares, to give them any idea of the value of what he held. Since that time negotiations had been going on, and now the Eastern Company offered £1 12s. per share for that which only about sixteen months ago they offered £2 10s. For his own part he could not see how to account for the apparent depreciation in the value of this company's property. If some company could be obtained to take up their cable to Alexandria, now lying dormant, this company would so tap the Eastern Company and probably pay a good dividend upon their property, and also a handsome dividend for whoever might lay the cable, and we know that there are contractors to be found in the present day who will take the cost of laying the cable in shares of the company. I believe we have paid to the Eastern Telegraph Company, as intermediates, £165,000. We are offered 4 per cent. debenture stock for our property. Now, as Mr. Adams observes, 4 per cent. debenture stock of the Eastern Company would not be worth at the outside more than from £85 to £95, therefore it reduces the actual proposal which they make considerably below £1 12s. They suggest an appropriation of part of your reserve fund to make up any deficiency in their offer; but that does not constitute any portion of the value of your property in question. Another great feature is this. According to my view of the case, the interest which they would pay, presuming you accept their offer, of something like £40,000, at 4 per cent. would be £1,600 a year. Now they would save almost the whole of that amount; it would come back to them in saving working expenses, &c., because their company could do your work at very little additional cost, so that actually they would get the whole of your property for something like £400 a year. That appears to me as a shareholder sadly too low, and I say again I cannot see any reason for the discrepancy between £2 10s. which they offered sixteen months ago and £1 12s. which they offer now. They have taken the least minimum market price of the day; indeed, I believe that something like £1 17s. 6d. may be obtained for your shares to-day, and yet they only offer £1 12s. Now when you deduct the expenses and one thing and another, it shows the very small price they are offering for your property. However, as the chairman and Mr. Ponsonby have justly said (and it is my own opinion as well) it is a shareholders' question entirely, and the directors do not wish to bias in any way the opinion which you as shareholders choose to adopt, but they will carry out, as I said at the commencement, faithfully and truly whatever you choose to suggest as most advisable for your interest.

Mr. Beck inquired if any officers of the company would be taken over.

The Chairman said he believed some of the staff could be taken over; and, of course, it would be the duty of the company to recompense those who were not. They have been many years in the service of the company—some of them. They would have to be paid out of the reserve fund.

Mr. Beck said he was glad that the chairman agreed with him that they would have to be recompensed.

A Shareholder asked what steps had been taken towards getting a renewal of the guarantee from the Government.

The Chairman here read a letter by himself to the Treasury, dated 24th August, asking if there were any likelihood of a renewal of the guarantee, but to that he received a negative reply. The letters were as follows:—

MEDITERRANEAN EXTENSION TELEGRAPH CO., LIMITED,
GRESHAM HOUSE, OLD BROAD STREET, E.C.,
LONDON, August 25th, 1882.

SIR,—I have the honour to submit the following proposition, on behalf of the Mediterranean Extension Telegraph Company, which I trust may meet with the favourable consideration of the Lords Commissioners of the Treasury.

This Company was originally constituted under the sanction of the Governments of Great Britain and Sardinia, in 1857, with the object of connecting the Islands of Sardinia, Malta, and Corfu by submarine cables, and a guarantee of 6 per cent. per annum was granted by Her Majesty's Government on £120,000, the original capital of the company, for a period of 25 years.

The cable between Cagliari (Sardinia) and Malta was [illegible] destroyed by volcanic eruption at the bottom of the se[illegible] between Malta and Corfu being also interrupted, a[illegible] was made with Her Majesty's Government by wh[illegible] was confirmed, the company laying down tw[illegible] between Malta and Sicily and the other between [illegible] to replace the original cables which had been [illegible] both these lines, and especially on that betwe[illegible] proved very satisfactory, and during several [illegible]

amount of the guarantee was required from Her Majesty's Government, and between the years 1863 and 1866 no call whatever was made upon the Treasury in that respect.

In 1869, the Anglo-Mediterranean Telegraph Company (now the Eastern Telegraph Company) duplicated their line between Malta and Alexandria, and called upon the Mediterranean Extension Company to lay a second cable between Malta and Sicily, as they maintained that one line would prove insufficient for the traffic between Alexandria and the European continent. The Mediterranean Extension Company accordingly raised additional capital and complied with the request, but shortly after the establishment of this second line between Malta and Sicily, the Anglo-Mediterranean Company extended their line from Malta to Gibraltar, and thence to Lisbon and Falmouth, and thus diverted to their new route all the messages between England and the East which had hitherto passed over the wires of the Mediterranean Extension Company.

A concession was subsequently granted by the French Government to Baron Erlanger for the establishment of telegraph lines between Marseilles and Bona (Algiers), and from Bona to Malta, and Her Majesty's Government, notwithstanding the earnest protest of the Mediterranean Extension Company, gave permission to Baron Erlanger to land and work his cable at Malta, which naturally proved most prejudicial to the interests of both the company and Her Majesty's Government, as these new lines (which were afterwards sold to the Eastern Company) abstracted all the traffic between Egypt and France which had previously been transmitted by the Mediterranean Extension Company's cable *viâ* Sicily and Italy.

I would, however, beg to draw my Lords' attention to the fact that notwithstanding these heavy blows and severe losses of traffic sustained by the company, they continued to manage their business with so much economy, and with such partial success, that up to the present moment the average payments made by the Treasury have only amounted to £3,231 per annum, while under the guarantee Her Majesty's Government were liable to the payment of £7,200 per annum, or more than double the amount actually received by the company.

The period of terminating the agreement between Her Majesty's Government and the company is now approaching, and it will legally become void on 2nd December of the present year.

I am therefore induced to lay this short statement before my Lords, and to solicit the renewal of the guarantee of Her Majesty's Government in such modified form as they may consider advisable.

I am aware that a telegraphic communication with Corfu is no longer of any importance for Government purposes, but I venture to submit that it would be clearly to the advantage of Her Majesty's Government to grant a small subsidy rather than abandon an existing telegraph line with Malta by which messages could be sent to and from Great Britain either through Italy and *France*, or through Italy and *Germany*.

Should the cables between Malta and Gibraltar, or between Gibraltar, Lisbon, and Falmouth become at any time interrupted, this alternative line of communication might prove invaluable to British interests, and to Her Majesty's naval and military departments, especially in the event of certain political complications in the Mediterranean, which might possibly develop from the present critical state of affairs in Egypt.

The Mediterranean Extension Company could not, however, hope to continue the working of this line between Malta and Sicily in face of the severe competition already mentioned, without some encouragement and support from Her Majesty's Government, and I therefore trust my Lords may be induced to grant renewal of a portion of the present guarantee, on condition of the line being maintained in good working order.

I am, Sir, your obedient servant,
(Signed) J. R. CARMICHAEL, Chairman.

P.S.—A copy of this application has been forwarded to Her Majesty's Secretary of State for War and to the Lords Commissioners of the Admiralty, for their information.

TREASURY CHAMBERS,
October 17th, 1882.

SIR,—I have laid before the Lords Commissioners of Her Majesty's Treasury your letter of the 25th August last, requesting that the guarantee of Her Majesty's Government might be continued to the Mediterranean Extension Telegraph Company, Limited, after the expiration of the present agreement on the 2nd December next.

I am directed, in reply, to inform you that my Lords regret that they can hold out no hope of a prolongation of the present agreement after its expiration on the 2nd December next, or of the renewal of the guarantee of Her Majesty's Government in a modified form.

I have the honour to be, Sir, your obedient servant,
LEONARD COURTNEY.

The Chairman,
Mediterranean Extension Telegraph Company,
Gresham House,
Old Broad Street, E.C.

Capt. Turner then moved and Mr. Beck seconded "That the offer of the Eastern Company be rejected."

The proposition was put to the meeting and carried amidst cries of "All, all."

A vote of thanks to the chairman, proposed by Mr. Price and seconded by Mr. Wheeler, concluded the proceedings.

THE FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).

extraordinary general meeting of the Faure Electric Accumulator npany (Limited) was held at the Cannon Street Hotel, on Monday, er the presidency of Sir A. J. Otway, M.P., when the subjoined resolution, which was passed at the extraordinary general meeting of the company held on Monday, the 6th of November, was submitted for confirmation as a special resolution :—"That the scale of voting by the shareholders, as at present prescribed by clause 64 in the Articles of Association of the Faure Company be altered, and that a clause be substituted in lieu thereof in the following terms :—'That, on every question to be decided by a poll, every member present, in person or by proxy, shall have one vote for every ordinary share up to ten inclusive, and he shall have an additional vote for every five shares beyond the first ten ordinary shares up to 100 inclusive, and an additional vote for every ten ordinary shares beyond the first 100 shares. And the holder of every ten deferred shares shall have the same number of votes in respect thereof as if they were one ordinary share, every ten deferred shares being, for the purposes of voting, always equivalent to one ordinary share. No member shall have more than 500 votes in all, and no member shall be entitled to vote on a poll as the holder of any shares in respect of which he shall not have been registered for three calendar months previous to the meeting.'"

Mr. Herbert Canning, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have heard the notice read convening this meeting, and therefore are aware of the object for which we are called together to-day. It is formally for the confirmation of the resolution which was passed, I think, with unanimity on the last occasion on which we met. But subsequently a later circular was issued, which intimated that possibly some important statements affecting the conduct of the company would be put before the meeting. That seems to me to be really the point that most interests us to-day. The confirmation of the resolution will be merely a formal matter, and I daresay those who approved it on the last occasion will not be now inclined to alter their opinion. With regard to the important statements announced, I ask your serious attention. I think I said in another room in your presence that I always considered a straightforward, outspoken course should always be taken between directors and shareholders. I do not understand any other way. Therefore I shall not depart from it. Therefore, when directors have decided upon any course of direction to be taken which may affect the interests of the company, it is our duty to make it known to you. Therefore, gentlemen, I make no apology for the announcement that statements which might be of importance would be given to you to-day. I will endeavour to make them very clear and intelligible to you. The general meeting the other day with unanimity approved of the project of M. Philippart with regard to the proceedings of this company; and I may be allowed to say, in passing, that I recognise in M. Philippart a man of very remarkable ability and very special knowledge with regard to the accumulator. I have said that more than once. My impression is that in any matter he undertakes he will try to succeed. I have every reason to hope that it will succeed. I hope he will succeed, for the sake of the company. I believe if it does succeed it will be of very great pecuniary advantage to this company. That I think also is the unanimous opinion of my colleagues on the board. There is one important thing in conducting the business, which, if it was more important than another, was that if the manufacturing the accumulators was to be done in England, and if the business of this company was to be done in England, and if the business of this company is to be carried on in England, I felt it was essential that the directors of the company should be English; on the other hand, if the making of the accumulator is not to be carried on in England, and if the business is to be transferred to another company, I am not sure that English directors are best or in the right place. When the affairs of the business of the company are in the hands of another company, I should not be the proper person to conduct the business any longer, if that is to be the order of the future. I find I am quite in concord with the members of the board. It would not be necessary for us, and we doubt if we should be the proper persons in these circumstances, to conduct the business of the company. After we separated we submitted the plans that were submitted to us for the conduct of the business of the company in the future, and I think we considered them with every desire to give effect to the unanimous opinion, as expressed by the general meeting on the occasion to which I refer. We did not find ourselves able to concur in the mode, when it was proposed to carry into effect that resolution. I do not wish to say one word against it, not one word. I think M. Philippart perfectly well knows what he is doing and how to conduct business according to his custom, especially in France. The mode of procedure did not commend itself altogether to us. I have not been, and I am not aware that any of the directors have been, connected with the financial operations of this company. We have considered this company more as an industrial than a financial one. Moreover, the method of procedure did not seem to correspond to our notions as to the way the business of this company should be conducted. We came to the conclusion that the necessity of the position was, when the new mode of procedure came to be carried into effect, we should not be the persons to give effect to it. We think that either the directorate should be more limited, or gentlemen more in accord with M. Philippart's views should be associated with him. In accordance with this, we should have to ask you to elect some gentlemen to fill our places at once, but we remembered that we have an obligation to the shareholders in connection with the Société la Force et la Lumière, who undertook to give one fully paid-up share for two £2 paid shares to any shareholder who might hold shares at this moment, in regard to his shares so transferred. I think, as that obligation was undertaken while we were still administering the affairs of the company, that it is right and proper, and seems to me to be our duty, to remain on the board to see that obligation fulfilled (hear, hear). The fulfilment of that obligation does not take place until January 1st. Unless M. Philippart previously determines it or comes to some decision, we shall consider it our duty to remain in the position that we are in until the 1st January. There is no necessity after that that we should continue to sit here. I

[illegible]

... would be equally good. He hoped by the end of March that the shareholders would receive back a sum equal to the amount of the money they had put into the Faure Company, and they would possess beyond that a share of equal amount in the French company, the owner of all the French patents. Whether they paid £2 or £10 per share, they would get the whole of the money back which they paid into the Faure, and be left the possessors of an equal amount of value in the company possessing all the French patents. Having given them these few details, he would make a few remarks upon those of the chairman as to the future action of the directors of this company. He could quite enter into the feelings of the directors, who said for the future the thing would be more French than English, and it was probably right that the management of the concern should be in the hands of those gentlemen in France and not in England. But he did not see the necessity for all of them to retire; he could quite understand that the majority might be French gentlemen, but he did not see why some of the gentlemen of the present board should not remain. But that was a personal question which he could not decide for them.

A Shareholder asked whether the Faure Company would cease to exist in that case?

The Chairman: Oh, no.

The Solicitor: The Faure would not cease to exist unless M. Philippart chose to give them back the sum they had paid into the Faure, and they were handed the French shares. The Faure would then practically cease.

M. Philippart said if the shareholders received back all the money they had paid into the Faure Company, and all the profits they drew in the future were out of the French company, he did not see the necessity for taking up two boards of directors, one at home and one abroad.

The Chairman: That is exactly the view of the directors.

A Shareholder remarked that he thought he understood that all their interests in the hands of the present directors would die and be taken by the French directors.

Another Shareholder asked, supposing a man held fifty shares at £10 each, and another fifty at only £2, what would be the return to those two categories of shareholders?

[illegible] would get £2 per [illegible] had been addressed to [illegible] for two shares, [illegible] was carried out, [illegible] was before the 1st of [illegible] of them is exchanged, [illegible] for two £2 paid shares [illegible] would they get [illegible] they would get four [illegible] they had taken up a [illegible] (laughter.) [illegible] of £2 each and gave [illegible] were each paid or [illegible] that in cash or receive [illegible] (laughter.) [illegible] made was simply a [illegible] desires, and that a general [illegible] when the time came. If four [illegible] have four sovereigns [illegible] a piece of paper representing [illegible] had accepted the exchange [illegible] need not trouble themselves [illegible].

[illegible] have not accepted the [illegible]

[illegible] event of the shareholders [illegible] would be wound-up?

[illegible] a question for the shareholders.

[illegible] to one remark by M. [illegible] company had need come to [illegible] So much in new companies had to [illegible] they could not expect to have a [illegible] such an invention. They were so far [illegible] was going on exceedingly favour[illegible] which was consistent with [illegible] required a very great deal of [illegible] working of the company that [illegible] anywhere near liquidation. He hoped [illegible] about to start on would bring them [illegible] he had no concurrence with the [illegible] he spoke the feelings of the board too. He [illegible] against M. Philippart, for he had always [illegible]. He believed M. Philippart lighted up [illegible] paid for gas, and if he could do that, [illegible] he would bring great profits to this company. [illegible] he would not depart from the line of business which was [illegible] to his mind, for one which did not commend itself to him. He wished the shareholders every success, and as he was a shareholder with them, he hoped M. Philippart's scheme would be successful. He thought M. Philippart had given a complete explanation of his scheme, and all he (the chairman) had to object to in it was that this company would be in no way led into liquidation had his plan never been started.

This being all the business before the meeting,

Mr. Leon proposed a vote of thanks to the chairman, thanking him for his open and frank conduct in dealing with the shareholders.

The Chairman, in reply, said that the board had endeavoured to do their duty conscientiously, and he only hoped the shareholders would meet with the success that had been promised them.

The Oriental Telephone Company.—A second extraordinary general meeting of this company was held on Monday last, Colonel Gouraud presiding, for the purpose of confirming the resolution passed at the extraordinary general meeting of November the 13th, 1882. The meeting was purely of a formal nature and lasted only a few minutes.

The creditors of the Telephone Supply Company (Limited) are required to send in the particulars of their claim to the liquidator by the 15th inst., and of Henry Rees and Company (Limited) by the 12th of January next.

The secretary of the West India and Panama Telegraph Company writes that the company has received advice of the repair on the 1st inst. of the cable between Jamaica and Ponce, Porto Rico, thus restoring direct telegraphic communication with all their stations except Grenada, Trinidad, Demerara, and the Isthmus of Panama.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company (Limited). The number [illegible] over the lines of this company during the month of November [illegible] mated to produce £1,800, against 2,334 messages, producing [illegible] in the corresponding month of last year. The August receipts, estimated at [illegible] £2,595.

The Direct Spanish Telegraph Company (Limited). The [illegible] month of November, 1882, are £1,998, as against £1,910 [illegible] period of last year.

The Eastern Telegraph Company. The traffic receipts for the month of [illegible] were £54,098, against £49,829, in the corresponding period of [illegible]

The Eastern Extension Telegraph Company. The traffic receipts [illegible] November, 1882, were £32 591, against £32,5?? in the corresponding [illegible]

The Western and Brazilian Telegraph Company (Limited). [illegible] the week ending 24th November, 1882, were £2,713, after [illegible] of the gross receipts payable to the London Platino [illegible] Company (Limited).

West India and Panama Telegraph Company (Limited). [illegible] receipts for the half-month ended the 30th November [illegible] with £2,254 in the corresponding period of 1881. The A[illegible] at £4,374, realised £4,362.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 264.

THE SURVEYOR OF CHELSEA ON THE ELECTRIC LIGHT.

WE were favoured last week with a copy of the report on electric lighting made by Mr. Stayton, C.E., the surveyor to the Chelsea Vestry. We could not at the moment deal with the matter as it deserved, and therefore preferred to leave it over until a more favourable opportunity presented itself of dealing with the subject. Mr. Stayton, in the course of his duties, entered very fully into the question of electric lighting, and the results of his relations with various electric light companies respecting the lighting of Chelsea by means of electricity are very instructive and will show just to what extent such companies are prepared to act. Mr. Stayton commences with an analysis of the Electric Lighting Act, but upon this point we need not dilate.

It appears that the applications received by the Vestry for consent to the granting of a licence by the Board of Trade were from :—

The Metropolitan Brush Electric Light and Power Company.

The Jablochkoff Electric Light and Power Company.

Notices of intention to apply to the Board of Trade for a provisional order were also served upon the Vestry on behalf of :—

The Metropolitan Brush Electric Light and Power Company.

The Edison Electric Light Company.

The Swan United Electric Light Company.

The "Pilsen"-Joel and General Electric Light Company.

The Gülcher Electric Light and Power Generator Company.

The West Middlesex Electric Light Company.

Messrs. Ferranti, Thompson, and Ince (Limited).

The Surveyor thinks that local authorities must look to the Board of Trade in a great measure for protection against the inconveniences which may arise in consequence of their hands being forced, as it were, by the action of certain speculative companies, who have indiscriminately given notice of application for licences and provisional orders, not only in the metropolis but throughout the country.

Mr. Stayton was apparently determined upon making a thorough investigation into the pretensions of the electric light companies, and he therefore sought particulars on some of the principal points upon which definite information was required :

(*a*) The terms on which a company would contract with the vestry under Section 11 of the Act.

(*b*) The area or areas of supply.

(*c*) The regulations for breaking up streets.

(*d*) A description and cost of the works.

(*e*) The amount of capital required.

(*f*) The probable cost of street lighting as compared with gas.

(*g*) The scale of charges for supply of electricity.

(*h*) The mode of measurement for all purposes and description of electric meter.

(*i*) The provision for accumulators or secondary batteries, or other means for steadiness, regularity, and amount of supply.

(*j*) The provisions for public safety and danger to property.

With a view to obtaining this information the surveyor communicated with the various companies mentioned, and subsequently with Messrs. Siemens Bros. We may add here that the parish contains about forty miles of streets and 12,000 houses, and that the existing street lighting is effected by means of 1,250 gas-lamps at a cost of £4,500 per annum, gas being supplied at three shillings per thousand cubic feet.

Concerning the information required (*a*) to (*j*), Mr. Stayton tabulated a series of twenty questions for the companies to consider and answer. Our space is too limited to allow of publishing these questions in our columns, although we would otherwise be glad to do so, in order that our readers might judge of the uncertainty and want of harmony in the answers given. We can, however, give some of the more important.

QUESTIONS.	METROPOLITAN (BRUSH).	EDISON.	JABLOCHKOFF.	SWAN.	FERRANTI, THOMPSON, AND INCE.	"PILSEN"-JOEL.	SIEMENS BROTHERS AND CO.
AS TO LICENCE.							
1. In the event of the vestry obtaining a licence, would your company be willing to contract with them, as provided by the 11th section of the Act?	Yes.	A company to work the Edison patents in the South Western district is in process of formation, and the carrying out of any installations in the Chelsea district would devolve upon them.	Yes.	Not answered.	This company are anxious to see all the vestries apply for provisional orders, and in the event of their so doing, desire to contract as proposed under the 11th section of the Act.	Not at present, but the company would be glad to help the vestry by supplying the apparatus required on the best possible terms.	Our company intend to remain as much as possible manufacturers, we would therefore not be inclined to undertake the contract of lighting any district.
10. What is the probable size of the electric conductors, and mode of laying same?	About ½ to ¾ inch diameter, and laid in cast iron pipes, which are buried two feet below the road surface. In order to lay these pipes a trench two feet deep, and about one and three-quarters wide, has to be dug.	The size varies according to the number of lamps it is intended to supply, and their distance from the generating or central station.	The conductor used for the "Jablochkoff" light is 7 strand, 16 B. g. properly insulated; this will distribute the light over an area of 20 miles' circumference.	The main conductors will be laid in cast-iron troughs, about 6 in. by 10 in. underneath the flagging of the footway and near to the kerb. In some cases it will be found convenient to lay them in two cast-iron pipes, about 4½ in. external diameter each.	Dependent on the length of mains and number of lights.	About ⅜ inch in diameter, to be laid in wooden troughs.	The size depends upon the number of lights it has to supply. We should employ wires 1 in. diameter, and increase their number as the demand for electric lights increased. The iron pipes would be laid first and fitted with road boxes every fifty yards, and the leads drawn in afterwards as occasion requires.

QUESTIONS.	METROPOLITAN (BRUSH).	EDISON.	JABLOCHKOFF.	SWAN.	FERRANTI, THOMPSON, AND INCE.	"PILSEN"-JOEL.	SIEMENS BROTHERS AND CO.
16. Does your system include the use of accumulators, if so, of what kind and where are they to be fixed?	Our system includes the use of accumulators of the usual kind, although we are not dependent upon them. They would be fixed in each house having the light, or at convenient intervals in or along the lines joining the lamps, or with the generators. Details not yet decided.	We do not recognise the use of accumulators as economical or necessary in the Edison system of distribution.	No accumulators necessary.	We propose to use accumulators as soon as they are fairly in the market. We consider they will be a most useful adjunct, but should be unable to tender for them in our present scheme.	No. We consider accumulators unnecessary for a compact district like Chelsea.	It is advisable in many instances to use accumulators.	It might be advisable to use accumulators, which could either be fixed in the houses or at the stations, or in both.
17. How is uniformity and steadiness of light maintained?	The uniformity and steadiness of the Brush Arc Light is maintained by the excellence of the regulator and the homogeneity of the carbons. Those of the incandescent light by the supply of current being uniformly delivered through the lamps. The use of secondary batteries renders the result doubly sure.	The nature of the Edison system is such that absolute steadiness and uniformity in the lighting is secured.	A good *steady-going* engine, *perfect* conductors, and *pure carbons*, are a safe guarantee to a perfect light.	By dividing our plant into several sets of generating machinery, each consisting of one steam-engine and several dynamo machines, each set being further controlled by an electric governor, which varies with the speed of the engines according to the electromotive force of the mains.	By driving large dynamo from large engine at a uniform speed. Our present lights so run keep perfectly steady.	By providing adequate power and accumulators, if possible, but *more especially* in having a form of lamp the working of which is *automatic*.	Uniformity and steadiness of light would be attained by employing efficient governors with the steam-engines, and by the use of accumulators.
18. What provisions have you for keeping the lights going in case of a breakdown in the machinery?	Duplicate machinery and accumulators.	By the immediate switching in of a spare dynamo. Thus with a central station having, say, *six* large dynamos, only *five* would be employed at once. The breakdown of one of these would produce (owing to the regulating arrangements) no discernable variation of the light, and the time required to put spare machine in action would not exceed one minute.	Duplicate engines and dynamos.	The full number of sets will normally be worked at from ½ to ⅔ of their maximum out-turn of current, so that if by accident any one or even two sets should be disabled, the engines of the other sets would only have to increase their speed and maintain the normal electromotive force, and supply all current in the mains. This arrangement of several sets of machinery all run into one main, also insures great uniformity and regularity in the supply of the current.	A spare engine and dynamo would be quite sufficient, as the machine is so simple and durable that there is little or no chance of failure or accident.	Accumulators will do this.	The accumulators would guard against a breakdown, and if they are not employed, spare machines would be kept in readiness to supply the place of broken down ones; or the electrical machines might be driven usually at a slow speed, so that if one of their number broke down, the remainder could be driven faster, and so keep up the supply.
19. How do you provide for the public safety, and against danger to property?	By the most perfect insulation or safety junctions, and every other available protection.	By a system of safety plugs throughout every part of the installation. Only in the Edison system is this carried out in a complete and efficient manner.	Proper insulation and ordinary precaution in workmanship.	Our electromotive force is so low that there would be no danger to life or even the least personal inconvenience to persons touching the wires. Regarding danger from fire from improperly arranged conductors, we propose to submit all our work to the inspection of the officials of the Fire Insurance Companies. With ordinary precautions we are convinced that danger from this source is far less than from any other method of lighting.	By perfect insulation and good workmanship, and this could be done under supervision of your own inspector.	By doing the work carefully, intelligently, and in a manner to meet the conditions of the case.	The leads being underground would be inaccessible, and the electromotive force being kept low, no danger could result even if anybody came in contact with the leads. We should also observe the rules drawn up by the Council of the Society of Telegraph Engineers with regard to fire risks from electric lighting, a copy of which we enclose.

We have only referred to a few of the leading questions, but we must confess with Mr. Stayton that a careful perusal of the tabulated statement reveals a somewhat curious diversity of opinion as to the manner in which the work should be done, and the result of the inquiries is undoubtedly disappointing, as many of the answers are very indefinite or incomplete.

Summed up the case stands thus: only three companies would contract to light any portion of Chelsea, the Brush, Jablochkoff, and Ferranti, Thompson, and Ince; but the companies were not prepared to give terms, excepting the Jablochkoff, which would undertake the work conditionally for 1½d. per lamp per hour. It appears from this that the Jablochkoff Electric Light Company is the only one at present prepared to do any work on an extensive scale, or [illegible] finite knowledge of the extent of its resources.

This, perhaps, is nothing to be surprised at, for the Jablochkoff system has been in operation longer than any other in England, and although worked in a quiet sort of way, there is no doubt but that the representatives of this system have amassed a considerable amount of experience, which now stands them in good stead. We have every reason to believe that this company will eventually take a leading position amongst electric lighting companies—a position which should never have been, for the time being, lost. *Apropos* of this we refer our readers to the article on the Dandeu-Chertemps machine, containing a report by Mr. Robert Sabine. Returning to the original subject of our remarks, we find that Mr. Stayton comes to the following conclusions:—

1. That at present it is not desirable for [illegible] apply for a licence or provisional order.

2. That it is not desirable to consent to any application for a licence until the draft shall have been submitted to, and has received the approval of, the vestry.

3. That the solicitors be instructed to watch the progress of the applications for provisional orders, and to take all necessary steps to oppose the same until satisfactory conditions are obtained.

4. That it is desirable to support the application of any company who may appear most likely to carry out the undertaking in a satisfactory manner, and who will agree to such of the suggested conditions as the Board of Trade may approve; and that the Electric Lighting Committee and the surveyor be empowered to enter into the necessary negotiations for effecting that object.

The report as a whole is one of the most comprehensive and complete which we have had the pleasure of perusing, and it demonstrates how valuable must be the advice of a competent engineer in assisting a local authority in arriving at a definite decision. That the Chelsea Surveyor is really a supporter of the electric light may be inferred from his remark that "although gas has done good service in the past, and will no doubt be continued both as an illuminant and heating power, yet its manufacture and consumption create many evils. There can therefore be but little doubt that so soon as greater economy in the production of electricity can be satisfactorily proved, it will gradually supersede gas for lighting purposes to a considerable extent."

THE ROYAL SOCIETY.

(*Continued from page* 447.)

The subject of Technical Education has continued to be prominently under the notice of the country during the past year. The appointment of a Royal Commission on Technical Instruction, to which I have previously referred, has done much towards awakening the interest of manufacturers, and exciting curiosity in regard to the efforts that are being made abroad to improve the education of artisans. The Commissioners issued in March last their first Report, which dealt exclusively with primary education and apprenticeship schools. The Commissioners expressed an opinion adverse to the establishment of apprenticeship schools in this country; and in this view they are supported by nearly all our large manufacturers, and by the action of the City and Guilds of London Institute for the Advancement of Technical Education. At the request of the Executive Committee, I myself gave evidence before the Commission, explaining generally the objects of the City Guilds and Institute, and describing the progress already made towards their attainment. As a member of the Executive Committee of this Institute, I have watched its progress with interest, and have observed with satisfaction that its scheme of Technical Instruction is being gradually matured. The general Examinations in Technology undertaken by this Institute, were held in May last at 147 centres in 37 subjects. Of the 1,972 candidates who presented themselves for examination, 235 passed in Honours, and 987 in the Ordinary Grade. In 1881, 895 candidates passed, showing an increase of 307. The examinations were held this year for the first time under the revised regulations, which appear to have worked very satisfactorily. Two points deserve notice with respect to these examinations. In the first place, the Institute experiences very great difficulty in obtaining properly qualified teachers. The applicants are either practical men working in the factory, or at their trade with no scientific knowledge whatever, or men possessing a very elementary science knowledge, and little or no practical acquaintance with the details of the industry, the technology of which they profess to understand. In order to indicate the kind of qualifications required in an ordinary technical teacher, the Institute has inserted in its programme a paragraph to the effect that persons who are engaged in teaching science under the Science and Art Department, and who at the same time have acquired a practical knowledge of their subject in the factory or workshop, may be registered as teachers of the Institute. The second point calling for consideration is the fact referred to in the Report of the directors: that of the 1,222 candidates who, this year, passed the examinations, most of whom are workmen or foremen in various branches of industry, not more than 450 are qualified to receive the full technological certificate, by having previously passed the examinations of the Science and Art Department in certain subjects. This fact clearly indicates that widely beneficial as the action of this department of State, there is still a large field for its influence among the population who are engaged in manufacturing processes and desire to receive technical instruction.

One of the most satisfactory results of the examinations of the City and Guilds of London Institute is the impulse they have given to the establishment, in different parts of the country, of properly equipped technical schools. At Manchester, Preston, Dewsbury, Hawick, Sheffield, Leicester, and other places, efforts have been made during this year towards organising schools for the technical instruction of artisans and others in the application of science and art to specific industries. At Nottingham, a grant of £500 has been made by the Institute, to be followed by an annual contribution for a limited period of £300, towards the establishment of technical classes in connection with the University College; and at Manchester a subscription of £200 a year has been promised to assist the funds now being raised for the conversion of the Mechanics' Institution into a Technical School. The attention of the Council has been greatly occupied of late with the arrangements for the opening of the Finsbury College. Classes in electrical engineering and in technical chemistry have been carried on for nearly three years in temporary rooms belonging to the Cowper Street Schools. The attendance at these classes has been eminently satisfactory, much more so than could have been anticipated. During the past session 960 class tickets were sold at fees varying from 5s. to 12s. The staff of the College has recently been doubled by the appointment of a professor of mechanical engineering and a head master to the new department of applied art, the establishmeut of which, as I stated last year, was then under the consideration of the Committee. In January next, it is anticipated that the new building in Tabernacle Row, which is already nearly completed, will be opened for the reception of students. The programme of instruction, prepared by the director and the professors of the College, has been for some time under the consideration of the Committee, and it is hoped that in the instruction given in this College will be found the realisation of a very important part of the Institute's scheme of technical education.

Grants to the technical science classes at University College and King's College, London, to the Horological Institute, to the School of Art Wood Carving, and other institutions, have been continued during the past year.

The Technical Art School in Kennington Park Road, established and maintained by the Institute, has been satisfactorily attended; and a proposition is to be brought before the Committee for supplementing the teaching of this school by technical science classes, with the view of establishing in the south of London a technical college for artisans, similar to the one about to be opened in Finsbury.

The building of the Central Institution or Technical High School in Exhibition Road, the foundation-stone of which was laid by H.R.H. the Prince of Wales, President of the Institute, in July, 1882, is rapidly advancing, and promises to be completed within a year. It is not expected, however, that this school will be ready for the reception of the students before the commencement of the session 1884-5. Meanwhile, the Council and Committee are fully occupied with the development of other parts of their scheme. . . . . .

This is, perhaps, the proper place to make mention of some results having an important bearing on meteorology, obtained by Prof. Tyndall in the course of a larger research on the action of radiant heat on gases.

By methods which he has applied to gases and vapours generally, Tyndall has established anew the action of aqueous vapour upon radiant heat, and the sensibly perfect diathermancy of dry atmospheric air. The phenomena of solar and terrestrial radiation are profoundly modified by the presence of aqueous vapour in the earth's atmosphere, the temperature of our planet being thereby rendered very different from what it would otherwise be.

The celebrated experiments of Patrick Wilson, wherein were observed a rapidity of radiation and a refrigeration of the earth's surface previously unknown, are explained by the fact that when they were made the amount of aqueous vapour in the air was infinitesimal, the unhindered outflow of heat towards space being correspondingly great. The sagacious observation of Six and Wells, that the difference between the surface temperature and that of the air a few feet above the surface, on equally serene nights, is greatest in cold weather, is explained by the fact that when the temperature is low, the agent which arrests the surface radiation is diminished in quantity. Wells, moreover, found that the heaviest dews were deposited on nights when the difference between air temperature and surface temperature was small; while the greatest difference between the two temperatures was observed on nights when the deposition of dew was scanty. The explanation offered by Tyndall is this:—copious dew indicates abundant vapour; and abundant vapour, by arresting the terrestrial rays, prevents the refrigeration observed in drier air. Strachey's able discussion of observations made at Madras, points distinctly to the action of aqueous vapour on the radiation both of the sun and of the earth; while the experiments of Leslie, Hennessey, Hill, and other distinguished men, which were long considered enigmatical, are readily explained by a reference to the varying quantities of vapour with which the atmosphere is charged, on days of equal optical transparency. The interesting observations of Desains and Branley, made simultaneously on the Rigi and at Lucerne, are well worthy of mention here. The difference of level between the two stations is 4,756 feet, and within this stratum 17·1 per cent. of the solar heat was proved to be absorbed. This absorption being due to aqueous vapour, is tantamount to the tranmission of the sun's rays through a layer of water of a definite thickness. A sifting of the rays would be the consequence, and on *à priori* grounds we should infer that the percentage transmission through water at Lucerne must be greater than on the summit of the Rigi. This was the exact result established experimentally by Desains and Branley. H. Wild, the distinguished Imperial Astronomer of St. Petersburg, basing his statement on experiments made by himself according to Tyndall's method, has expressed the opinion "that meteorologists may, without hesitation, accept this new fact in their endeavours to explain pheno-

mena which hitherto have remained more or less enigmatical." The correctness of this statement is illustrated by the foregoing examples, to which, if necessary, many more might be added. . . . . .

The scientific year now concluded has not been so fertile as its predecessor in the initiation of great national and international undertakings, neither have any of those larger enterprises which I took occasion to mention last year, such as the circumpolar observations, or the Transit of Venus Expeditions, as yet been brought to their final issue. Nevertheless, in some of them we have evidence that good work is already being done, and in the others, of which we have as yet no information, there is no reason to doubt that the same is the case. Nor again, in the border-land between science proper and its applications, have I to record anything so important as the Paris Electrical Exhibition. That Exhibition, however, bore legitimate fruit in the Electric Lighting Exhibition at the Crystal Palace, and in the technical experiments lately carried out on a large scale at Munich. Perhaps the most prominent feature of the Crystal Palace Show was the incandescent light. At Paris that mode of illumination appeared to be little more than a possibility, in London it had become an accomplished fact. The importance attaching to this advance in electric lighting may be measured both by the rapid extension of its use, and also by the fact that not a few of our leading minds consider that the incandescent lamp is the lamp of the future, not merely for domestic, but even for many other public purposes.

But in another way the present year has witnessed the most important step which could have been taken for the promotion of electric lighting in this country. The Legislature has passed the Electric Lighting Bill, and, so far as legislation can effect the object, it has brought electricity to our doors. Up to this time installations of greater or less magnitude had sprung up sporadically in many parts of the country, in railway stations, manufacturing works, and occasionally in private houses. But, compared with the lighting of a whole town, or even of separate districts of a large city, even the most important of these must be confessed still to partake of the nature of experiments; experiments, it is true, on a large scale, and, as I believe, conclusive as to the ultimate issue. Indeed, by multiplication of machines it is certainly, even now, possible to increase the lighting power to any required extent; but this can hardly be regarded as the final form of solution of the problem, inasmuch as such a method would be as uneconomical as it would be to use a number of small steam-engines instead of a large one. And when we consider that at the time of the passing of the Act in question, there was but one machine actually constructed which was capable of illuminating even one thousand incandescent lamps (I mean that of Edison), we cannot but feel that much remained to be done before the requirements of the public could be fully met. I do not mean thereby to imply that the Act was passed at all too soon; on the contrary, it has already given just that impetus which was necessary for producing installations on a larger scale. In illustration of this, I cannot help mentioning, as the first fruit of the impetus, a remarkable machine, by our countryman Mr. J. E. H. Gordon, which appears capable of feeding from five to six thousand lamps.

But beside the impulse above described, the Bill will have a scientific influence perhaps not contemplated by its original promoters. Under this Act, for the first time in the history of the world, energy will come under the grasp of the law, will become the subject of commercial contracts, and be bought and sold as a commodity of everyday use. It is, in fact, far from improbable that the public supply of electricity will be reckoned and charged for in terms of energy itself. But whether this be literally the case or not, a measurement of energy must lie at the root of every scale of charge.

And, further, since the Act allows no restriction to be placed upon the use of the electricity so supplied, it follows that it may be used, and undoubtedly will be used, at the pleasure and convenience of the customer, either for lighting, or for heating, or for mechanical, or for chemical purposes. This being so, it is clear that the public must by this process become, practically at least, familiar with the various modes of the transformation of force; and the Act in question might, from this point of view, have been entitled An Act for the better Appreciation of the Transformation of Force.

While offering to the public this new commodity, electricians may, in one respect, especially congratulate themselves, namely, that their article is incapable of adulteration. An electric current of a given strength and given electromotive force is perfectly defined, and is identically the same, whether it comes from a Siemens or a Gramme, from a magneto or from a dynamo machine, or as suggested by an eminent counsel before the Select Committee of the House of Commons, from one machine painted red or from another painted blue.

It has been said, and perhaps with truth, that the electric light will be the light of the rich rather than that of the poor. But in more ways than one electricity may now become the poor man's friend. The advantages in avoidance of heat and of vitiated atmosphere in workshops and factories have often been pointed out, and may ultimately become an important factor in the physical growth and prosperity of our population. But besides this, when electricity is literally brought to our doors, it will become possible, by converting it into motive-power of limited extent, to revive some of the small industries which, during the last half century, have been crushed by the great manufacturing establishments of the country. There are operations which are capable of being carried out by the wives and families of workmen; there are works of small extent which can be performed more advantageously in a small establishment than in a large one, and it can hardly fail to be a gain to the community if this new departure should give fresh opportunities for the development of our industry in these directions. . . . . .

A Royal Medal has been awarded to Lord Rayleigh, M.A., F.R.S.

The researches of Lord Rayleigh have been numerous and extend over many different subjects; and they are all characterised by a rare combination of experimental skill with mathematical attainments of the highest order.

One class of investigations to which Lord Rayleigh has paid much attention is that of vibrations, both of gases and of elastic solids. The results of most of these researches are now embodied in Lord Rayleigh's important work on the "Theory of Sound"—a work which not only presents the labours of others up to the time of writing in a digested and accessible form, but is full of original matter.

The subject of vibrations naturally leads on to a mention of other hydro-dynamical researches. Lord Rayleigh has investigated the motion of waves of finite height, and in particular has shown that the "great solitary wave" of our late Fellow, Mr. Scott Russell, has a determinate character; and he has investigated the circumstances of its motion to an order of approximation sufficient to apply to waves of considerable height.

Lord Rayleigh has examined more fully than had previously been done the theory of diffraction gratings, and the effects of irregularities; and also investigated the defining power of optical combinations, and its limitation by diffraction and spherical aberration.

He has lately been engaged in the elaborate re-determination of the B.A. unit of electrical resistance. . . . . .

The attention of chemists had for many years past been directed to the relations between the atomic weights of the elements and their respective physical and chemical properties; and a considerable number of remarkable facts had been established by previous workers in this field of inquiry.

The labours of Mendeleeff and Lothar Meyer have generalised and extended our knowledge of those relations, and have laid the foundation of a general system of classification of the elements. They arrange the elements in the empirical order of their atomic weights, beginning with the lightest and proceeding step by step to the heaviest known elementary atom. After hydrogen the first fifteen terms of this series are the following, viz:—

Lithium	7	Sodium	23
Beryllium	9·4	Magnesium	24
Boron	11	Aluminium	27·4
Carbon	12	Silicon	28
Nitrogen	14	Phosphorus	31
Oxygen	16	Sulphur	32
Fluorine	19	Chlorine	35
		Potassium	32

No one who is acquainted with the most fundamental properties of these elements can fail to recognise the marvellous regularity with which the differences of property, distinguishing each of the first seven terms of this series from the next term, are reproduced in the next seven terms.

Such periodic reappearance of analogous properties in the series of elements has been graphically illustrated in a very striking manner with respect to their physical properties, such as melting-points and atomic volumes. In the curve which represents the relations of atomic volumes and atomic weights analogous elements occupy very similar positions, and the same thing holds good in a striking manner with respect to the curve representing the relations of melting-points and atomic weights.

Like every great step in our knowledge of the order of nature, this periodic series not only enables us to see clearly much that we could not see before; it also raises new difficulties, and points to many problems which need investigation. It is certainly a most important extension of the science of chemistry.

REVISED EDITION OF PATENT RULES.

(*Continued from page* 451.)

DIRECTIONS AS TO *Sizes and Methods of Preparing* PETITIONS, DECLARATIONS, COMPLETE SPECIFICATIONS, DRAWINGS to accompany the same, and COPIES thereof.

XXIX. All petitions for the grant of letters patent, and all declarations, shall be respectively written or printed upon sheets of paper of twelve inches in length, by eight inches and a half in breadth (but on one side only), leaving a margin of one inch and a half on every side of each page.

XXX. All complete specifications accompanying petitions for the grant of letters patent shall be respectively written or printed bookwise upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth; the same may be written or printed upon both sides of the sheet, but a margin must be left of one inch and a half on every side of each page.

XXXI. The drawings accompanying such complete specifications shall be made upon a sheet or sheets of parchment, each of the size of twenty-one inches and a half in length by fourteen inches and three-fourths in breadth, or twenty-one inches and a half in breadth by twenty-nine inches and a half in length, leaving a margin of one inch and a half on every side of each sheet.

XXXII. The copy of the complete specification to be left at the office of the commissioners on filing the complete specification, shall be written or printed upon sheets of brief or foolscap paper, briefwise, and upon one side only of each sheet.

XXXIII. The copy of the drawing, or drawings, to be left [illegible] the copy of the complete specification, must be made [illegible] white smooth-surfaced drawing paper of the same dimen[illegible] parchment drawing. All the lines must be absolute[illegible] ink of the best quality to be used, and the same [illegible] of the ink maintained throughout the drawing [illegible] be in lines, clearly and distinctly drawn, and a[illegible] for [illegible] with the required effect. Section lines sho[illegible]

drawn. No colour must be used for any purpose upon this drawing. All letters and figures of reference must be bold and distinct. The border line should be one fine line only. The drawing must not be folded, but must be delivered at the office of the commissioners either in a perfectly flat state, or rolled upon a roller, so as to be free from creases or breaks.

XXXIV. In all cases where the original drawing on parchment is coloured, there must be left, in addition to the above copy, another copy coloured.

TRANSMISSION OF COPIES, TRANSCRIPTS, &c., TO EDINBURGH AND DUBLIN.

XXXV. The office of the director of chancery in Scotland, being the office appointed by the Act for the recording of transcripts of letters patent, shall be the office of the commissioners in Edinburgh for the filing of copies of specifications, disclaimers, memoranda of alterations, provisional specifications, and certified duplicates of the register of proprietors.

XXXVI. All such transcripts, copies, and certified duplicates shall be bound in books, and properly indexed, and shall be open to the inspection of the public at the said office, during office hours, every week-day, except 1st January, 10th February, Good Friday, Queen's Birthday, 20th June, 28th June, 9th November, and 25th December.

XXXVII. The charge for office copies of such transcripts, copies, and certified duplicates, recorded and filed in the said office, shall be at the rate of twopence for every ninety words.

XXXVIII. The Enrolment Office of the Court of Chancery in Dublin (late Rolls Office, now Record and Writ Office) being the office appointed by the Act for the enrolment of transcripts of letters patent, shall be the office of the commissioners in Dublin for the filing of copies of specifications, disclaimers, memoranda of alterations, provisional specifications, and certified duplicates of the register of proprietors.

XXXIX. All such transcripts, copies, and certified duplicates shall be bound in books and properly indexed, and shall be open to the inspection of the public at the Public Record Office of Ireland during office hours on every working-day.

XL. The charge for office copies of such transcripts, copies, and certified duplicates, enrolled and filed as aforesaid, shall be at the rate of twopence for every ninety words.

(Signed) SELBORNE, C.
G. JESSEL, M.R.
HENRY JAMES, A.G.
FARRER HERSCHELL, S.G.

Dated the 8th day of November, 1882.

APPLICATIONS TO THE LORD CHANCELLOR.

Ordered by the Right Honourable Roundell Baron Selborne, Lord High Chancellor of Great Britain:

I. Every application to the Lord Chancellor against or in relation to the sealing of letters patent shall be by notice, and such notice shall be left at the office of the commissioners, and shall contain particulars in writing of the objections to the sealing of such letters patent.

II. Whereas by the Act 16 & 17 Vict. c. 115, the Lord Chancellor is empowered to extend the time for the sealing of letters patent for an invention, and for the filing of the specification thereon, limited to the period of one month after the expiration of the six months of provisional protection of such invention, provided the delay in sealing such letters patent and in filing such specification has arisen from accident, and not from the neglect or wilful default of the applicant.

It is ordered as follows:—

Every petition addressed to the Lord Chancellor, praying for the extension of time for the sealing of letters patent, and for the filing of the specification thereon under the provisions of the Act of the 16 & 17 Vict. c. 115., and the affidavit accompanying the same shall be left at the office of the Commissioners of Patents. And in every case where the delay in sealing such letters patent and in filing such specification is alleged to have been caused by adjourned hearings of objections to the grant of such letters patent before the law officer to whom such objections may have been referred, the petitioner, before leaving his petition as aforesaid, shall obtain the certificate of such law officer to the effect that the allegations in respect of such adjourned hearings and causes of delay are, in the opinion of such law officer, correct, and that the delay arising from such adjourned hearings has not been occasioned by the neglect or default of the petitioner; and such certificate shall be written at the foot of or shall be annexed to such petition.

(Signed) SELBORNE, C.

Dated the 8th day of November, 1882.

LAW OFFICERS' ORDERS.

Ordered by Sir Henry James, Her Majesty's Attorney-General, and Sir Farrer Herschell, Her Majesty's Solicitor-General:

I. In every application for letters patent, the applicant must insert in the petition and in the declaration his full name and his address or his principal address, if he have more than one residence or place of business; but only one address must be given.

II. In every application for letters patent for an invention which is not the discovery of the applicant, the petition and the declaration must state the source of the invention in the following form, or to the following effect:—

(a.) That it is a communication from [*A.B.*], a person resident at [*here state address*].

(b.) That it is the result partly of a communication made to me by [*A.B.*], a person resident at [*here state address*] and partly of invention and discovery made by me.

(Signed) HENRY JAMES, A.G.
FARRER HERSCHELL, S.G.

Dated the 8th day of November, 1882.

LIST OF STAMP DUTIES AND FEES PAYABLE ON AND IN CONNECTION WITH LETTERS PATENT.

ON APPLICATION WITH PROVISIONAL SPECIFICATION.

	£	s.	d.
Stamp on petition for letters patent	5	0	0
To be paid on giving notice to proceed	5	0	0
To be paid on applying for warrant and patent ...	10	0	0
Stamp on final specification	5	0	0
Total cost of patent for three years	25	0	0

ON APPLICATION WITH COMPLETE SPECIFICATION.

	£	s.	d.
Stamp on petition for letters patent	5	0	0
Stamp on complete specification	5	0	0
To be paid on giving notice to proceed	5	0	0
To be paid on applying for warrant and patent ...	10	0	0
Total cost of patent for three years	25	0	0

SUBSEQUENT PAYMENTS TO CONTINUE THE PATENT IN FORCE.

	£	s.	d.
Stamp on patent before expiration of 3rd year	50	0	0
Ditto ditto 7th year	100	0	0
Total cost of patent for fourteen years	175	0	0

ON OPPOSITION TO GRANT OF LETTERS PATENT.

	£	s.	d.
To be paid by person opposing grant, on giving notice of objection...	2	0	0
To be paid by petitioner, also by person opposing grant, on the hearing of the case of opposition, each ...	3	10	0

ON OPPOSITION TO THE SEALING OF LETTERS PATENT.

	£	s.	d.
To be paid by person opposing the sealing, on giving notice of objection...	2	0	0

ON DISCLAIMERS, MEMORANDA OF ALTERATIONS, AND OPPOSITIONS THERETO.

	£	s.	d.
Stamp on petition for leave to file a disclaimer or a memorandum of alteration	5	0	0
Stamp on caveat against a disclaimer or a memorandum of alteration	2	0	0
To be paid by petitioner for the hearing previous to the fiat of the law officer	3	5	0
To be paid by person opposing allowance, on the hearing of the case of opposition	3	5	0
To be paid by petitioner for fiat of law officer allowing a disclaimer or a memorandum of alteration	3	15	6

OTHER PAYMENTS.

	£	s.	d.
On registering assignment, licence, &c.	0	5	0
For duplicate of letters patent	5	0	0
For every search and inspection	0	1	0
For office copies, every 90 words	0	0	2
For certifying every printed copy of a specification ...	0	1	0

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ON THE APPLICATION OF ELECTRO-MOTIVE POWER TO MARITIME PURPOSES.

By A. RECKENZAUN, C.E.

THE honourable distinction of bringing the scheme of steam navigation to a successful issue is due to Fulton; he, we are told, had long been studying the steam-engine of his time, solely with a view to its employment in the propulsion of vessels. Learning that a steam-boat was being built in Scotland, as an experiment for Lord Dundas, he visited this country in the year 1802, and gained some useful information in the very diminutive engine-room of this model boat called the "Charlotte Dundas." From England Fulton went to France, in the hope of influencing the interest of Napoleon in his design, and to obtain that emperor's support in this his great project. Fulton returned to America, however, disappointed, for Buonaparte refused any assistance; so he then, nothing daunted, executed the drawing which he sent to Boulton & Watt for them to construct the machinery therefrom, since it was desirable this should be carried out in the best manner then known. In the year 1807 Fulton launched his first steam-vessel on the River Hudson, and which for a long time ran regularly between New York and Albany,

steaming at a speed of four miles an hour; subsequently increased to six miles per hour.

Fulton's success in America soon called the attention of the Scotch engineers to the marine engine, but it remained for another than Symington, the designer and constructor of the "Charlotte Dundas," to develop this grandest of all grand industries in Great Britain.

I have referred thus briefly to these well-known facts in the early history of the development of the marine-engine, and of those connected with it, because it is well at all times to bear in mind how ardently must those first pioneers have worked, how steadfastly they pursued their object in spite of so many and such enormous difficulties, disappointments, and opposition. They laboured under the disadvantages of an imperfect knowledge of physical science; they had no approved theories upon which to found their practice; no books to assist them in collecting, comparing, and arranging facts; no societies where they could discuss their views; nor did they possess the simplest instruments or even the tools needful to produce the desired results. Nevertheless they and their successors ultimately succeeded admirably, although we must admit that their representatives of to-day are neither idle nor oblivious to the fact that perfection has not yet been attained. Fuel is expensive and requires much room, which can ill be spared in these high-pressure days, amid the keen race between competition and demand; and acting upon the worthy precept to—

. . . "Count nothing done
While aught remains to do,"

Man, ever eager to press into his service all and everything around him, has been for years past striving to tame the very lightning, so to speak, and make it contribute to his thirst for gain. Thus of late what has been for years naught but the assumption of theorists, the dream of physicists and the firm conviction of perhaps one (Faraday) has at last assumed a practical shape. We have to-day within the ken of the "oldest inhabitant" the vast change from the rushlight and horn-lantern of his childhood to the brilliant, almost blinding illumination of the electric light; and from the postchaises and heavy-rolling rumbles, and the slow-paced canal-barge of his youth to the electric railway and, may I not add, the electric-launch of to-day.

This leads me to the subject with which we are more immediately concerned at present, viz., this storer and conveyer of motive-power and its general adaptability to various purposes connected with navigation.

To the designer and constructer of the first *successful* electric-boat comparatively small credit is due: he had at his disposal volumes of knowledge; theories, formulæ, calculations, facts worked out by his forerunners ready to his hand; the most perfect tools to work with; he could get his electric-motor ready made. His sole task was in the application and adaptation of known contrivances, and all that he required beyond this was a practically useful battery; this was furnished as quickly, as skilfully, and as complete as he could desire.

Upon the subject of the storage of electricity, Prof. Silvanus Thompson presented us a year ago with his advanced views; dwelling, with a charming command of language and knowledge, upon the great advances recently made in science and their ultimate importance to industry in general; and, whilst developing his subject from the general laws of voltaic electricity to their particular adaptations, he encouraged the world to further research with the promise of ultimately attaining still grander results. More recently this *savant* gave us, through the Press, a short account of the labours of Jacobi and Trouvé.

Jacobi, Professor Thompson tells us, constructed an electric-boat at St. Petersburg, in the year 1838, on which an electro-magnetic engine was worked by a Daniell's battery, composed of 320 couples of zinc and copper, each 36 square inches in area, but the speed attained was not more than $1\frac{1}{4}$ miles per hour. In the following year Jacobi made an improvement, however, by substituting 68 Grove cells—the area of the platinum plates being the same as that of his zincs in the Daniell battery. The boat was 28 feet long by $7\frac{1}{2}$ feet beam and less than 3 feet in depth; it held 14 persons and reached a speed of $2\frac{1}{4}$ English miles per hour on the river Neva.

The ELECTRICAL REVIEW, in an article on electrical navigation, records an attempt made upon the lake in the Bois de Boulogne in 1859 to navigate a boat by electricity, but it does not inform us of the name of its originator.

These attempts at utilising primary batteries for motive-power proved, *naturally*—as present experience has taught us—failures. Professor Carey Foster demonstrated the fallacy of consuming zinc instead of coals, six years ago, in a very interesting discourse at South Kensington. Professor Foster said that there seemed to be no reason to believe that electricity could ever be economically used as a motive-power; the cost of fuel for smelting an amount of zinc sufficient to do a certain amount of work would be much more profitably spent in doing work *directly* in a steam-engine. This is quite true so far; but we must wonder why this learned man, who, perhaps better than any others, must have known of the existence of the Planté secondary battery, did not in any way refer to its usefulness. The Planté cell has been known for many years, but comparatively little importance has been assigned to this grand discovery; indeed, we began but very recently to realise that it must be counted as one of the grandest, one of the most useful of this century.

M. Trouvé, of Paris, was one of the first to utilise the Planté accumulator for motive-power purposes, and he was the first who propelled a boat by means of these cells and an electro-motor of his own construction. This experiment he successfully carried out on the River Seine.

The Faure battery is a modification of the Planté, and so are a large number of others (including the Sellon-Volckmar accumulator) which have been brought into the world—at any rate as far as the Patent Office—during the past twelve months.

The original Faure accumulator differs very little in appearance from the Planté, but gives slightly different results under certain circumstances. The Sellon-Volckmar accumulator, although composed of the same materials, seems to be superior to its forerunners, both in mechanical effect and durability: it is *absolutely certain* in its action, is compact, simple, and produces a maximum efficiency as regards weight and power.

Faure places the oxide of lead upon the surface of the lead-plates; the red lead is applied in the form of paint, and this paint is kept upon the plates partly by its natural adhesion and partly by the mechanical pressure exerted by the substance dividing the plates. The uncertainty of action with many of these accumulators is caused principally by the separation of the lead from its oxide; thus the superior mechanical construction of the Volckmar lead-plates is a decided advance in the right direction.

Mr. Volckmar perforates his lead-plates and fills the perforations with the oxide, and in such a manner that it is entirely prevented from falling out or separating; in fact we can bend these plates considerably without destroying their efficiency. This is not only a good quality, it is *absolutely essential* to purposes of conveyance from place to place under the influence of vibration, such as exists on railways, tramcars, and boats.

However, I propose to confine myself to the application of electric energy to purposes directly connected with the navigation of the sea and rivers.

In order to render this motive-power of use on board a ship it must show superior qualities; electrical power, to be useful, must be as convenient and as cheap as steam-power; it must be certain in action at all times and under all circumstances; the appliance for conveying electric energy must be compact, light, easily managed and manipulated by a man of ordinary intelligence, free from danger, and always under command.

Space and weight are probably of first importance in this connection; next, however, comes the cost—prime cost, maintenance, the consumption of material, waste, and wear and tear. Keeping within the bounds of experience, I can show that, for small vessels, such as launches, torpedo-boats, &c., electrical machinery has a decided advantage, space for space, over that required for steam-power; hence in this description of craft it will doubtless become a successful rival. A steam boiler is always a bulky object when compared with the size of a boat; the steam-engine, although comparatively small, is still not so convenient in shape as a dynamo machi[illegible] or electro-motor. The accumulators, though heavier, [illegible] as easily stowed away as coals and possess this [illegible] advantage over coal that their weight does not [illegible] too [illegible]

thus they are greatly superior as ballast, and maintain a constant and invariable draught of water for the propeller to work upon. An electro-motor giving out, say, 10 horse-power will not weigh more than 10 cwt. and, when fixed to the floor horizontally, need not stand higher than 15 inches; therefore, if we work the screw-propeller direct from the motor, the space occupied by the whole machinery is very inconsiderable. The weight of a 10 horse-power electro-motor, as I have said, need not exceed 10 cwt., whereas that of a 10 horse-power marine-engine with all its accessories, but *without* the boiler, amounts to at least 15 *cwt.*—machine for machine; thus we have a great gain in favour of the motor. Horse-power taken by the dynamometer on the screw shaft and *not* the indicated horse-power.

In a steamboat we have further to consider the weight of the steam-producer—the boiler—and that of the fuel; on the other hand for our electric-boat we must calculate that of our current-producer—the battery. We naturally assume a definite number of hours during which our supply of fuel or *force* may be required to last. Now, on a steam-boat, in order that it may run, say, 10 hours, with a 10 horse-power engine, we must carry about 10 cwt. of coals and a boiler which, when filled, weighs at least 30 cwt.—or together, without the engine itself, about two tons; adding to this the engine, we find we have no less a load to carry than some 55 cwt. On the other hand, on an electric-boat the batteries in order to be durable will weigh 50 cwt., which makes with the motor, say, 60 cwt. in all; but if we have thus nothing to balance in favour of electric-power, yet steam-launches seldom run continuously for any considerable time without stoppages for different purposes, and it is on these stoppages that we gain very materially, for, to maintain the steam in constant readiness to start, we must keep up a steady fire, and this means continuous consumption of fuel with no corresponding work done; our accumulators, on the other hand, consume practically nothing of our electric-force while at rest and, what is of greater moment still, no one has to stand by to attend to them during that time; they are perfectly safe and even improve by a little rest. They have what Professor Ayrton calls a resuscitating power; they regain strength and are thereby so much the better prepared for a start when the time comes. Since steam-boilers are dangerous they require the constant attendance of an engineer; since fires burn down they as surely demand the constant presence of a stoker.

A dynamo machine is composed of a very few pieces as compared with other engines, the fewer the details of a machine so much the less in proportion is the risk of a breakdown. In the case of a good dynamo there appears to be nothing of importance to get out of order. The commutator with its brushes seems really the only working part which wears or can give occasional trouble, and that but seldom, and only to a careless attendant. Fortunately we can easily carry a spare armature and plenty of spare brushes without the slightest inconvenience; moreover, all such vital parts of an electric engine can be always at hand, and be replaced at any moment with hardly any loss of time. If the wires are well protected the field-magnets cannot possibly get out of order; the armature, when securely wound, need never require attention. The only parts, then, are the bearings, the commutator, and the collecting-brushes, neither of which weighs more than a few pounds and can be replaced with ease, and as these working parts become improved, as we gain more experience still in this new branch of science, we may well look forward to obtaining in process of time an almost perfect motive-power.

The continents of America and Asia possess, in their rivers and canals, an immense natural system of internal communication; in fact, their waterways are as important as our railways; and it will, I doubt not, be in those countries that electric power will play a prominent part in inland communication. Those quarters of the globe are, by the same means, provided with an immense amount of water-power applicable to their needs. It would appear that a kindly providence has thereby supplied other means and natural forces where coal-fields are rare or absent; it only remains for man, therefore, to utilise them, transmit them to the most convenient centres of commerce and habitation, thus conferring incalculable advantages upon them. What does it matter if we have to transmit the water-power some 50 or 100 miles if we have the means of doing it at a profit? Is it not better to utilise 40 out of every 100 horse-power of energy contained in a waterfall, though it may be at a great distance from the place of its application, than to convey coals several thousands or even but hundreds of miles to the steam-engine? Having, then, these grand forces of nature at our disposal, and having discovered the means of turning them to good account, it is matter for surprise that more determined movement has not hitherto been made in this direction.

I do not know the limit of what might be done with electromotive power on inland waters or on the seaboard; but we have abundant evidence that it is very easy to run a distance of from 50 to 100 miles at a very considerable speed, sufficient for all practical purposes; but even if we were confined to very moderate distances there seems no reason why we should not erect stations for storage batteries at the necessary intervals whatever they may be.

With proper arrangements the whole set of cells can be taken out and replaced in an insignificantly short space of time, and the vessel can proceed at once, thus avoiding the delay occasioned by the necessity of recharging her own accumulators. But in many cases these generators could be established at those places where the vessels are compelled in any event to stop to load and unload their freight or debark their passengers; and while this is proceeding the cells may be charged through cables from the shore.

Proprietors of launches do not care themselves to undertake the necessary duties of watching the gauge-glasses and similar appendages to steam machinery; again—more unpleasant still to the delicate hands and mind of a yachtsman—there are the shovel, the dirty coals, the smoke, the heat, the smell of oil, matters quite inseparable from any steam-boat, even if the company of the dusty stoker be disregarded. Then the wages of these necessary helpers amount in the aggregate to more than the cost of the fuel; they must be there whether the passengers are on board or not; we may, therefore, well regard an electric-launch as a great boon, since it does not require any special skill in the management of its machinery, is free from heat and smell, from dirt and the need of constant attention, or the fear of explosion. I think it would add greatly to the pleasure of an excursion party if the course and the speed of their craft could be controlled quite independently of, not only wind and tide, but also of the company of an attendant. These advantages would, I am inclined to think, far outweigh every other consideration, even if the electric were as dear or dearer than steam-power.

Thus far I have simply dealt with pleasure-boats, of which there are thousands on the rivers, lakes, and bays of this and other countries; but the commercial world will demand further investigation: the man of business, the naval authorities, will require a more exact estimate of cost and maintenance, and not alone the proof of utility and greater convenience, ere they pronounce in favour of any novel contrivance, however excellent; and it is for this reason, and to meet this wider and more important demand, that I now propose to enter upon a more minute examination, and to put forward a few calculations respecting the power and cost of electricity, as here applied, and its adaptability to the purposes before us.

I take a lead plate $7\frac{1}{2}$ inches long, $5\frac{1}{4}$ inches broad, and less than $\frac{1}{8}$ inch in thickness; there are 560 square holes in this plate, and when these are filled with minium (lead oxide) it weighs less than *one pound!* A number of such plates are placed in a box, separated from each other by strips of wood, felt, or the like, and arranged so that every alternate plate is connected outside the box. We thus obtain two sets of connections, one of which will form the *positive*, the other the *negative* pole of the battery when charged; 40 of these plates with the separating material, acid, and box together need not weigh more than 50 lbs. They will, when charged, combine to produce a current of 50 ampères during a space of seven hours—or, in other words, 350 ampère hours. If discharged with a lower current, say, of 25 ampères they will last for at least fourteen hours—since the efficiency of any secondary battery depends upon the current and the time. All good secondary batteries, formed of lead with lead oxides in diluted sulphuric acid, give an electromotive force of 2·2 volts, thus we can accurately calculate the mechanical effect to be obtained from such an accumulator. Current × e.m.f.

$\times$ 44·25, will give us the number of foot-pounds; and this divided by 33,000 the actual horse-power. Therefore we get from the cell under consideration, with 40 plates, a force of ·134 horse-power per minute, or a total of about 56 horse-power in the seven hours—equal to a mechanical effect of 1,848,000 foot-pounds. Each plate—or nearly each pound of lead—would thus yield a power of $\frac{1,848,000}{40} = 46,800$ foot-pounds—an effect which has, probably, never been attained by any other accumulator (outside the laboratory).

Reducing our comparative figures with reference to the surfaces, we find that the two acting surfaces measure about 78 square inches in each plate, and the surfaces of the 40 plates combined give a total of, say, 3,120 square inches; thus we arrive at the conclusion that each square inch gives an energy of about 592 foot-pounds for seven hours and we have a current of one ampère for every 62·4 square inches. Every well-constructed accumulator gives, as I said, an e.m.f. of a little over two volts, and as this is a fixed quantity, whatever the surfaces or the number of plates, we can with ease arrange our calculations for any requirements and easily determine the number and size of our cells so soon as we know the required force. If, for example, we had to construct an electric-launch requiring an actual force of four horse-power for its propulsion, we should proceed first to determine the electrical energy necessary to run our motors; we know that a good dynamo-machine will yield an efficiency of 75 per cent.; in order then to obtain 4 horse-power on the propeller-shaft we must have at least 5 horse-power of electric energy to drive our motor. We assume a convenient current, say, of 40 ampères—how many cells will produce the necessary electromotive force?

We have $$\frac{E \times 40}{746} = 5 \text{ H. P.}$$

therefore $$E = \frac{746 \times 5}{40} = 93 \text{ volts,}$$

and, allowing two volts per cell, we require at least 47 cells. We know from experience that the Sellon-Volckmar battery requires only 62·4 square inches of surface (taking the two sides of the plates) for each ampère, so we can readily arrive at the most convenient size and shape of each cell.

(*To be continued.*)

ON MAGNETO-ELECTRIC AND DYNAMO-ELECTRIC MACHINES.

By J. ANGELO FAHIE, Inst. C.E., Ireland.*

Faraday's Discovery.—In the year 1831 the illustrious Faraday made the important discovery that by moving a coil of wire in the presence of a magnet a current of electricity was generated in the coil, or, *vice versa*, by moving the magnet and holding the coil stationary a like result was obtained, thus a current of electricity was obtained, either by moving a wire in the presence of a stationary magnet, or by moving a magnet in the presence of a stationary wire. The intensity of the current so obtained depended (1) on the strength of the magnetism present, and (2) on the velocity with which the coil was moved through the magnetic field. Upon this simple phenomenon is based the whole of the recent important development in electrical science, and to Faraday we owe the credit of having laid the foundation of the many useful inventions by means of which electric lighting, as well as the transmission of power, and the propulsion of tramcars by electricity has been made practicable to-day.

Now with the knowledge that it was possible to generate electric currents in the manner shown by Faraday, it only remained to devise some mechanical means whereby the different elements which produced the temporary or momentary currents could be combined, so as to collect them, and cause them to flow in rapid succession the one after the other without interruption.

Pixii's Machine.—The first attempt to devise an electrical machine was made by Pixii, who, in the year following the discovery of Faraday, constructed a machine consisting of a permanent magnet, which he caused to revolve in front of the iron cores of a pair of bobbins forming an electro-magnet. We find this invention was considerably improved upon by other workers in the field of science, especially by—

Saxton and Clarke, both of whom succeeded in producing very useful electric generators, in which the mechanical arrangement is the reverse of that in Pixii's—*i.e.*, the magnets are fixed and the coils of wire movable; and it is on this plan all the subsequent machines have been constructed, as affording better results than where the coils are stationary and the magnets movable. The little magneto machines still sold by opticians are constructed on this principle.

Following the inventions of Saxton and Clarke are those of the *Holmes* type, better known as the Alliance machines, which however, are now rarely used in this country, and we shall not, therefore, dwell upon them, but hasten on to the important invention of *Dr. C. W. Siemens*, who, in the early days of magneto electricity, accomplished a great deal towards reducing to practical form the principle of generating electricity by mechanical force. Dr. Siemens' improvement in 1857 consisted essentially in a new form of armature, the construction of which must be familiar to everybody, as, owing to its simplicity and cheapness, it is still used for many purposes, especially for electro-plating and laboratory work. It is composed of a cylinder of iron in which deep longitudinal grooves are cut, resembling in section the letter H. In these grooves is wound lengthwise a simple coil of wire, the two ends of which being joined to a split tube of copper on the axle, forming the commutator from which the current is taken off by brushes or springs rubbing against it. By this longitudinal armature the advantage was gained of cutting the greatest number of lines of force when rotated between the poles of a series of adjacent magnets. The modern armature used in the Siemens machine is somewhat more difficult and complicated in construction, and will be described further on.

A few years subsequent to the invention of Siemens, *Wilde*, of Manchester, hit upon an important improvement by constructing a machine consisting practically of two Siemens' machines combined—a large and a small one; and in the large one he dispensed with the permanent magnets and substituted electro-magnets, which he caused to be excited by the current produced by the smaller one. By this arrangement considerably more powerful currents were obtained than by any of the machines previously constructed.

*Siemens' and Wheatstone's Discovery.**—Next in the order of remarkable electrical phenomena comes the important discovery made simultaneously, but independently, by Dr. Siemens and Sir C. Wheatstone—a discovery which marks the transition of the *magneto*-electric machine to that type most in practice at present—the *dynamo* machine, called for convenience the dynamo. What Dr. Siemens and Sir C. Wheatstone discovered was this:—That a current of electricity could be generated in the coils on the armature by the feeble residual magnetism in the iron cores of the electro-magnets, and that by passing this feeble current round the magnets, their magnetism would be strengthened, which in turn would produce a stronger current in the armature, and this current would again react on the magnets, rendering them more powerful, this action going on until the limit of saturation is attained; for it must be understood that this mutual accumulation cannot go on indefinitely, the magnetism in the iron cores cannot be intensified beyond a certain point, and this point depends on and is controlled by the scientific conditions on which the machine is constructed.

Amongst the several machines constructed on the principle discovered by Siemens and Wheatstone, the most famous are those of Gramme, Siemens, Edison, Brush, Bürgin, and Gülcher. They differ chiefly in the construction of the armature and the arrangement of the electro-magnets. The electromotive force generated in each of them is proportional to the number of turns of wire in the rotating armature, and, within certain limits, to its speed of revolution. Currents of small electromotive force, but of considerable quantity, are obtained by making up the armature of only a few turns of stout wire, or bars of copper (as in the Edison machine), offering only a slight internal resistance. Currents of high electromotive force are produced by forming the armature of many coils of very fine wire and driving it very fast.

The term *electromotive force* may be compared to the pressure of water, being the electric condition necessary to overcome the external resistance of the circuit, just as a given pressure of water is necessary to overcome the resistance offered to its flow—for instance, to move the plunger of a hydraulic press; and as a given quantity of water under pressure is required to keep the plunger moving, so a given quantity of electricity under a given electromotive force is required to keep the lamp burning or the electro-motor moving, as the case may be. The unit of electromotive force is termed a *volt*, which is approximately equal to the force of a Daniell cell; the unit of resistance is an *ohm*, which is the resistance a current experiences in passing through a copper wire 10 feet long by 10 millimetres in diameter; and the unit of current, the *ampère*, which is one volt passing through one ohm in one second of time; or the volt divided by the ohm, and is represented by the equation:—

$$C = \frac{E}{R}$$

C being current, or ampère; E being electromotive force, or volt; R being resistance, or ohm.

Siemens' Modern Machine.—In a suitable frame, powerful, flat electro-magnets are fixed, the upper pair having their north poles facing one another and united by arched pieces of iron, and the under pair having their south poles similarly united. In the space thus formed between the upper and lower magnets the armature rotates, consisting of a cylinder round which are wound longitudinally a number of coils in a peculiar manner and crossing over each other at all angles at both ends of the cylinder, each end of each coil being connected with segments of copper mounted on the axis and forming the commutator. It will be observed that in this machine the two poles of the field magnets act simultaneously on each coil, an[illegible] double action operating on opposite sides of the coil [illegible] current has a contrary direction, the resultant effect [illegible]; hence [illegible]

Edison's Machine.—The next important de[illegible]e a success[illegible] shall notice in the Siemens type of genera[illegible]ject when comp[illegible] has succeeded in applying to practice [illegible]gine, although comp[illegible] structed. Its total weight is about [illegible] in shape as a dynamo [illegible] which is coupled on direct to the [illegible] of 900 ampères. An idea of its [illegible]umulators, though heavi[illegible] coals and possess this [illegible] their weight does not [illegible]

* Abstract of paper read before the Inst. C.E. Ireland, and to which we called attention in our "Notes" columns, *vide* ELECTRICAL REVIEW, Dec. 2nd.

* Mr. Fahie, like many others, app[illegible] conjointly with those of Wheatston[illegible] of the reaction principle.—EDS. El[illegible]

paring it with the largest Gramme made, which weighs only about one ton, and yields a current of only 90 ampères.

The Edison armature resembles in form that of Siemens, but differs essentially in the method of its construction. The iron core is built up of a number of sheet-iron discs, or washers, insulated from each other and bolted firmly together by bolts passing through them in a line parallel to the axis of the core. This method gives the advantage of a solid iron core, and prevents the circulation of local currents which are usually set up in solid cores, causing a loss of power. Instead of the usual insulated wire the coils are composed of heavy copper bars or prisms, longitudinally arranged, and insulated from each other and from the iron core underneath, and these bars are connected at each end by copper discs of the same diameter as those forming the core. This construction affords very favourable results, and the resistance of the armature is reduced to a minimum, while owing to the annular space between the bars and the core, a free circulation of air is maintained, thereby reducing the tendency to heat and increasing the capacity of the machine. Edison uses long cylindrical masses of metal for his field magnets, wound with only a few convolutions of wire; and by this arrangement he claims to secure a more powerful magnetic-field than by using the same weight of metal of shorter length.

The Paccinotti Type.—In the year 1860, Dr. Paccinotti suggested the use of an iron ring wound round with insulated wire, which he caused to rotate between the poles of permanent steel magnets. The object of Paccinotti was, however, rather to produce an electro-motor-engine, than a machine for generating electric currents; and the advantages of the ring armature remained therefore unrecognised until it found its first practical application in the invention of M. Gramme, of Paris, as introduced and described before the French Academy of Sciences in 1871.

The Gramme Machine is generally considered the simplest form of apparatus for generating electricity by mechanical means. At any rate its action is easily understood. Around the soft-iron ring, which forms the core of its armature, a series of independent bobbins, or coils, are wound, the ends of which are connected to copper plates in such a way as to constitute an endless coil wound in one direction around the ring. The plates are insulated from each other, and so arranged as to form a commutator. This ring is caused to rotate between two powerful electro-magnets, each provided with polar extensions overlapping about two-thirds of the outer periphery of the ring. The magnets are excited by the currents generated in the coils, and the currents flowing from the machine are caught up by brushes or combs which press on the commutator.

The Gramme machine is very popular, and is extensively used both in England and on the Continent.

The Brush Machine.—Closely resembling the Gramme in its general outline appearance, but differing materially in construction and action, is that known as the Brush dynamo, which has recently come into extensive use in the United States and England. For currents of high electromotive force the Brush machine is considered a good one. Its armature, though consisting of a ring like that of Gramme's, is, however, differently "built up." At intervals around the ring a number of transverse grooves are formed, in which are wound the coils or bobbins, all in the same direction; and instead of forming a continuous circuit, as in the Gramme, each diametrically opposite pair of coils are joined to each other by one end of each coil, while the other ends of the pair (*i.e.*, the ends conveying the current) are connected to the commutator in such a manner that a portion of the current flows to the external circuit through one pair of brushes, while another portion of the current is conveyed round the electro-magnets by another pair of brushes. One coil of each pair, in fact, feeds the external circuit, while the opposite coil simultaneously magnetises the field-magnets of the machine itself, thereby strengthening the magnetic-field.

The Bürgin Machine, which is considered a useful and practical form of electric generator, is the invention of M. Bürgin, of Switzerland. Its peculiarity lies in the construction of its armature, which, instead of being a single ring as in the Gramme, is made up of several hexagonal frames mounted parallel to each other on the same spindle, and around each of these frames are wound a series of bobbins or coils as in the Gramme ring. By increasing the number of these frames and lengthening the electro-magnets a higher electromotive force can be readily obtained. This armature is considered very simple in construction, easy of repair, and the coils are easily wound, but the manner of joining them up is somewhat complicated and difficult to explain. The free access of air to the exposed surfaces of the frames prevents the coils being unduly heated by the current. This, at first sight, appears to be an advantage possessed both by the Brush and Bürgin machines over the ordinary Gramme, the armature of the latter being so closely and so thickly wound that it is apt to heat with the current when being driven at a high speed. This advantage is, however, questionable when it is remembered that since the ring in the one case is only partially surrounded with coils, in the other case it is completely enveloped. So that for rings of the same size, and driven at the same speed, the Gramme certainly gives out the greatest stream of electricity. The electro-magnets in the Bürgin machine are traversed in their entirety by the induced currents similar to the Siemens and Gramme machines.

The Gülcher Machine.—The last machine of the purely ring type worthy of note here is that known as the Gülcher, which is a modi[illegible]tion of Brush's invention, its armature being somewhat similar [illegible]inciple and form, with the difference that it is provided with [illegible]wo sections of wire, and rotates between eight field-magnets—[illegible]ach side. It is also provided with a new feature consisting [illegible] or shoes, forming three sides of a square fixed round the [illegible]t not only the sides of the revolving bobbins are under [illegible]uence but also their periphery.

[illegible] *Machine* is partly descended from the Gramme and [illegible] and is the only one at present in use which contains permanent steel magnets, all the other electric generators of recent construction containing the more compact and powerful electro-magnets. In construction the De Méritens' machine consists of a Gramme ring armature, mounted on a spindle and rotated within a circular frame, on which are placed horizontally a series of powerful steel horseshoe magnets on the principle of the earlier form of the Alliance machines. It gives alternating currents, and its coils can be connected in various ways so as to give tension or quantity currents, as may be required. Great efficiency is claimed for this generator, the adjustment of parts is simple and effective, and it is greatly liked by the British lighthouse authorities.

The use of dynamo machines in the generation of electricity for public illumination has now been sufficiently demonstrated to be both practicable and economical, especially in large areas where considerable light is required, such as railway stations, harbours, and public institutions, not to mention lighthouses, in which the electric light has been used with advantage for a number of years; and again in military operations dynamo machines play an important part in producing the intense light required for illuminating at night a distant point to be observed, or lighting up the work of the assailants in sieges. Evidence of their utility in this direction has recently been supplied in connection with the military operations during the late campaign in Egypt.

Next to its importance in the production of the electric light, probably the most useful purpose to which the dynamo has yet been applied is the transmission of power. This property depends on the principle known as the *reversibility* of the dynamo, or, in other words, the transformation of electrical energy into mechanical work, which is simply the converse of what we have been hitherto considering in regard to the means for converting mechanical into electrical energy. In the transmission of power by electricity the current is generated in one machine, from which it is conveyed to another, which may be at any distance, and may be utilised to set machinery of any kind in motion.

The distance over which the electric transmission of power may be carried without serious loss of energy is still a matter of controversy, not having been yet proved by works of any great magnitude. We have it, however, on the authority of Dr. Siemens, as the result of a long series of experiments made by this distinguished electrician, that the total loss resulting from the double process of conversion (*i.e.*, the conversion of mechanical into electrical energy, and secondly the conversion of electrical into mechanical work) is about 20 per cent. To this loss should be added that caused by the resistance of the wires, which depends on their length and sectional area; so that for actual work it is considered safe to assume that the loss sustained over a considerable distance does not exceed 50 per cent., which will not appear very great when compared with the loss sustained in transmitting power by compressed air, water, or other means.

Already tramcars have been caused to run over considerable distances in Berlin and Paris, by electricity transmitted from a stationary generator to one fixed on and coupled up with the axle of the moving vehicle. And in our own country we shall soon, let us hope, have the pleasure of seeing the first really practical attempt of applying successfully and economically the principle involved in the electric transmission of power to a distance. In the electric railway now in course of construction from Portrush to the Giant's Causeway, it is proposed to mount an electro-motor on each car, which will be connected with a stationary dynamo by means of a conductor laid along the rails, the rails themselves forming the return circuit.

It will be a matter of congratulation to the enterprise and scientific genius of Irishmen should this attempt prove successful, it being the first work on a large scale of the kind yet attempted in the United Kingdom.

In conclusion, the author trusted that he has succeeded in imparting some idea of the fundamental principles and construction, as well as of the useful applications of magneto-electric and dynamo-electric machines, through the agency of which, it is not too much to hope that we may live to see the vast power stored up in great waterfalls, in the perpetual flow of our rivers, in the rise and fall of our tides, and in the onward rush of mountain streams, utilised and rendered serviceable to the wants and conveniences of man.

ON THE TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

A VOLTAIC current thrown into any given conductor determines by induction a counter-current into a closed circuit which is adjacent and parallel. If we remove the inducing current we obtain in the same circuit a current opposite in direction to the first. If the resistance of the induced current is great enough, the two currents thus produced take the character of tension electricity and may reproduce the effects of ordinary electric machines. This is the theory of the Ruhmkorff coil.

It was therefore natural to ask if the system is not reversible; and if, in other words, on passing the discharge of an ordinary electric machine into the fine wire of a coil we might not obtain in the thick wire an induced current of a very feeble tension and analogous to voltaic currents.

It was only in 1875 that Bichet made his first experiments. With a Holtz machine and a Ruhmkorff coil he was able to decompose water and to deflect permanently the needles of a galvanometer. He stopped here, and whether he did not seize the full importance of his discovery, or that other more pressing researches drew off his attention he did not occupy himself with them further. Professor Goir also sought to transform static electricity into a voltaic current. The announcement of the discovery of the French *savant* caused him to suspend his labours, but he resumed them when he saw that Bichet had laid the question aside.

For the success of the experiment the electrical discharges must be rather strong. Without this condition (which is easily realised by the aid of condensers) the effects of the induced current will be too feeble to be easily observed. Another condition is that the interval between the inducing sparks must not be too great, so that the current may not lose the quasi-continuity which approximates it to voltaic currents.

This current, further, has a character by which it can be readily distinguished. Instead of being truly single and continuous, it is double and discontinuous. When the spark passes into the thick wire it determines an induced current in one direction, and, immediately after the passage of the spark, another current in the inverse direction, but the rapidity of the electric discharge is such that practically these two currents only form one. Another cause of discontinuity is the discontinuity of the inducing sparks. With the exception of these two characters the current behaves in all respects like the currents produced by batteries with liquids.

Its tension is at first very feeble, since it does not give a spark, even on the slightest interruption of the circuit. If the current is put into the acidulated water of a voltameter we obtain decomposition, and, under each receiver, we find a certain quantity of gas. As the current is continually inverted the gas is a mixture of oxygen and hydrogen, the proportions of which vary in each experiment. Perhaps, by suitably regulating the resistance in the induced circuit, we might find the means of eliminating one of the two simultaneous currents, and of thus separating one or other of the gases. If a galvanometer is interposed in the circuit, the needle is not sensibly deflected so long as the circuit does not present a special resistance; but, if we interpolate an interrupter (*e.g.*, Froment's vibrating reed), the needle is suddenly deflected, and this deviation is considerable enough to give a hope of the possibility of utilising the induced current.

If we cause one of the rheophores to communicate with a file and run the other over the teeth of the file we have a train of reddish yellow light like that which we obtain on repeating the experiment with the wet battery. This phenomenon is not that of the spark. It is due to particles of iron and carbon which are detached from the file under the action of the current, become fused or volatilised, and establish thus a kind of bridge between the teeth of the file over which the rheophore is passed.

The two rheophores terminating in very fine carbon points prepared for the voltaic arc are brought in contact. On separating them carefully we see at once a jet of electric light analogous to that furnished by the Gramme machine or the batteries. On repeating the experiment with a conducting wire and a mercurial bath we obtain a luminous arc due to the incandescence of the mercurial vapours. This arc is less bright, but more durable.

This induced current on circulating round a cylinder of soft iron produces rapid magnetisations in two opposite directions which may be shown either by the magnetic spectra obtained with iron filings or by the vibrations of a very light and mobile plate of iron.

Lastly, the most curious experiment of all—the induced current produced in a Ruhmkorff coil by electric discharges may be directed into a second coil like the current of a battery, and determine long sparks with which all the phenomena of the Ruhmkorff coil may be repeated.

Thus the result is a transformation of static electricity into a dynamic current. If with the small Holtz machine which served him as a current-exciter, M. Goir has been able to decompose water, to ignite a bad conductor, and to produce the voltaic arc we may hope by improving the apparatus to obtain powerful electric currents with the machines which produce static electricity, and that with a much less expenditure of force. Perhaps by multiplying, or better insulating, the discharges of atmospheric electricity, we may render ourselves masters of this agent, equally capricious and menacing, and turn it to domestic purposes.—*Les Mondes.*

NEW MODE OF EXPRESSING THE WORK AND THE ECONOMIC RETURN OF ELECTRICAL MOTORS.

M. MARCEL DEPREZ has just presented to the Académie des Sciences two very interesting notes upon this subject, which we shall sum up, regretting that the author thought proper to introduce a new word, the definition of which is somewhat complicated, and which for this reason will not for some time come into general use among industrial and practical men, that is to say, among those whom the question interests most. The theory is applied to the continuous motors of the Paccinotti type.

In a motor in motion there is equilibrium between the motive couple and the resistant couple. Let us suppose the resistant couple to be defined by a weight, F, suspended from a lever equal to 0^m159 (corresponding to a circumference of one metre of development). This couple will be constant whatever the speed of the ring may be. The motive couple, which gives equilibrium to this resistant couple, corresponds in the machine to an expenditure of energy equal to

$$\frac{r\,I^2}{9{\cdot}81} \text{ kilogrammetres per second.}$$

r = resistance of the machine in ohms.
I = intensity of the current in ampères.

This expenditure of energy has the effect of heating the wire, it is constant for a constant intensity, and completely independent of the state of rest or motion of the ring.

A fixed expenditure of energy, which depends on the intensity of the current, corresponds to a fixed motive couple, the resistance of the machine remaining constant. Representing the motive couple by the corresponding resistant couple, F, as we have just defined it, we have—

$$\frac{r\,I^2}{9{\cdot}81} = \rho\,(F). \qquad (1)$$

This power, ρ (F), varies with the arrangement and the absolute size of the motor; it can generally be only determined by experiment. Expressing by R the total resistance of the circuit, the total energy expended in the form of heat is equal to—

$$\frac{R\,I^2}{9{\cdot}81} \qquad (2)$$

We get besides by comparison (1)—

$$\frac{I^2}{9{\cdot}81} = \frac{\rho\,(F)}{r}.$$

Transposing in (2), we have for the total quantity of heat—

$$\frac{R}{r}\,\rho\,(F).$$

Adding to (3) the work produced by the motor, we shall obtain the total work expended by the generator.

Let F_1 and V_1 be the motive couple and the angular speed of the generator.

F and V the resistant couple and the angular speed of the motor.

The absolute work effected by the generator is $F_1\,V_1$ per second.

The work produced by the motor is F V per second.

The total heat given off in the circuit is—

$$\frac{R}{r}\,\rho\,(F).$$

We derive from this the equation—

Work expended by the generator.		Total heat.		Work produced by the motor.	
$F_1\,V_1$	=	$\frac{R}{r}\,\rho\,(F)$	+	F V.	(3)

And the economic return, K, is expressed thus—

$$K = \frac{F\ V}{F_1\ V_1} = \frac{F\ V}{F\ V + \frac{R}{r}\rho\ (F)} = \frac{V}{V + \frac{R}{r}\frac{\rho\ (F)}{F}}.$$

From the equation (3) we find—

$$F_1\ V_1 = F\ V = \frac{R}{r}\ \rho\ (F).$$

The work lost only depends for a constant couple on the ratio of the resistances, $\frac{R}{r}$. The return, K, depends on three factors. 1st, the speed of the receiver; it increases with it; 2nd, the ratio of the resistances, $\frac{R}{r}$; 3rd, the factor, $\frac{\rho\ (F)}{F}$, that is to say, on the relation of the heat developed in the receiver to the mechanical couple produced by the current. This is the quotient which M. Marcel Deprez calls the *prix de l'effort statique*—the value of the static force.

Practical results. We derive from the consideration of the value of the static force some interesting results from a practical point of view of which we shall give a summary.

The return increases and is nearer to unity for a given speed as $\frac{\rho\ (F)}{F}$ approaches more nearly to zero. The constructor should therefore seek, for a given weight of copper and iron, to vary the relative dimensions of the inductors and of the ring, as well as the mode of coiling the wire in order to diminish as much as possible the value of the static force.

The consideration of the value of the static force shows also that a single motor is better than a combination of similar motors of the same weight taken collectively.

In the second note presented to the Académie des Sciences on the 27th November, 1882, M. Marcel Deprez made known the fundamental experiment which allows of estimating that for a constant intensity the motive couple remains constant whatever the speed of the ring may be.

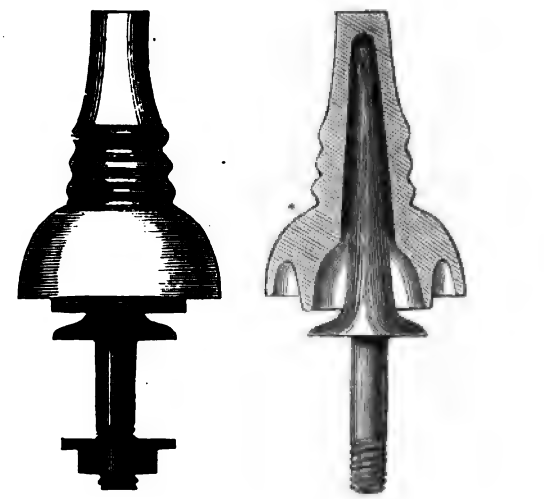
It follows as the last consequence that the difference of the electromotive force developed by the two machines remains also constant. In fact, let E be the electromotive force of the generator, e the electromotive force of the motor, R the total resistance, and the constancy of the intensity gives, by virtue of Ohm's law,

$$\frac{E - e}{R} = I = \text{constant};$$

R being constant, $E - e$ is necessarily so also.

LANGDON'S IMPROVED LEADING-IN INSULATOR.

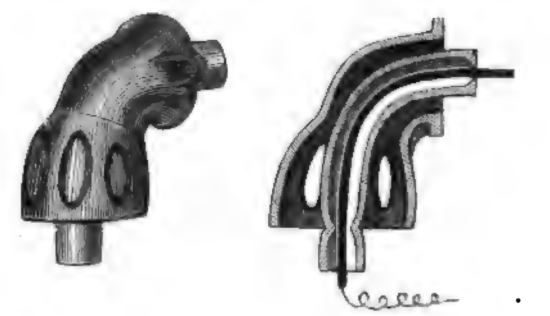
UP to the present time the only form of terminal insulator in very general use has been the Bright's shackle. This arrangement, although mechanically all that can be desired, is electrically very defective, the insulation of a complete shackle termination at its best being but ⅛th that of an ordinary insulator. The general method of leading the wire into the office from a terminal is also by no means a satisfactory arrangement. Mr. W. Langdon, the well-known telegraph engineer of the Midland Railway, has recently devised a very effective form of terminal insulator, and also an improved leading-in cup, which are decided advances on anything yet brought out. Figs. 1 and 2 show the new form of insulator. It will be seen that great mechanical strength is obtained by carrying the metal bolt a considerable distance up into the porcelain cup, so that the pull of the wire, which would in an ordinary insulator have to be borne by the porcelain alone, is here practically brought to bear on the bolt. By giving a very broad base to the flange of the bolt, the tendency of the whole insulator to become pulled over by the strain of the wire becomes reduced to a minimum. The bolt, it may be remarked, is constructed to withstand a strain of from 1,100 to 1,200 lbs. The insulator is provided with grooves, either of which may be used for the line-wire; but which will also be found particularly useful where copper wire is employed in conjunction with iron, the iron wire in such cases being attached at the lower, and the copper wire at the upper groove, the connection being formed by the ordinary loop. The bolt is of the usual dimensions, viz: to serve the ordinary 2½ in. by 3 in. terminal arm; it can be fitted to the ordinary shackle straps



FIGS. 1 AND 2.

if desired, by slipping a short piece of iron tube over the bolt and between the upper and lower straps, so as to keep the two straps apart.

The "leading-in cup," shown by figs. 3 and 4, is formed by enclosing an insulating tube composed of glass or porcelain in a perforated iron hood. The insulator tube projects at each end, at that nearest the pole for the purpose



FIGS. 3 AND 4.

of embedding it in the pole, and at the distant end that it may, by means of the perforation in the iron hood, become well cleansed by the rain. At a short distance from the mouth of the insulating tube, the space through which the gutta-percha arm is passed is contracted so as to centralise it, and thus keep it from touching the edge of the tube. A felt washer is used between the insulator and the pole. These leading-in cups have been employed for terminations, on "boxing" fixed to ordinary round creosoted poles, as well as on spare poles; in either case they form a very efficient and neat termination.

WRIGHT AND MACKIE'S GLASS BLOWING MACHINE.—We shall shortly place before our readers a full and illustrated description of this invention, which at present is applied to the manufacture of glass bulbs for incandescence lamps. It is a most useful adjunct towards the cheapening of these lamps, and greatly facilitates the rate of their production. Messrs. Wright and Mackie have by means of this machine, and their improved methods of forming the vacuum in the lamp bulbs, rendered a real service to the cause of electric lighting. Their works are being rapidly completed, and in a very short time it is expected that the manufacture of incandescence lamps will be carried on in a most rapid and extensive way. We believe we are correct in saying that Messrs. Wright and Mackie will be prepared to undertake the entire construction of any known system of lamps, and that they do not intend to limit themselves exclusively to any particular form. Doubtless several electric light companies will gladly avail themselves of the new and cheaper process of manufacture devised by these gentlemen.

THE DANDEU-CHERTEMPS DYNAMO-ELECTRIC MACHINE.

In the Electrical Review of June 10th there will be found an illustration and short description of this alternating current machine. We then expressed a hope that it would not be long before we could give fuller particulars respecting its efficiency. Until the present time we were not in a position to publish any details of experiments and tests performed with the machine, but we are now enabled to bring before the notice of our readers two reports on the Dandeu-Chertemps system, compiled by Mr. Robert Sabine, C.E. We may remark that the report dated June of the present year deals with the *first* machine constructed and sent into England, it being constructed solely for use with Jablochkoff candles, and differing in many details of manufacture from the later machines which form the substance of Mr. Sabine's subsequent report dated December, 1882.

Copy of Mr. Robert Sabine's First Report.

I have examined the dynamo-electric machine of Messieurs Chertemps & Dandeu, with the following results. I found the machine, which is designed to sustain ten Jablochkoff lamps, to be very compact and well made. It is on the alternative current principle, and self-magnetising. Its inducing coils are made to rotate, while those of the induced circuit are stationary, an arrangement which greatly facilitates any necessary supervision or manipulation of the main circuit while the machine is in motion. The supporting frame of the induced bobbins is constructed entirely of insulating material for the purpose of avoiding the development of the so-called Foucault currents, and this is unquestionably a means of saving engine-power and working the machine more economically than would otherwise be the case.

Photometric measurements were made with 2 up to 8 Jablochkoff lamps in circuit, when the machine was driven by a 4 (nominal) horse-power steam-engine, of which indicator diagrams were simultaneously taken, and it was found that the power expended in the machine, short conductors, and lamps increased as follows:—

Lamps on circuit.	Engine-power expended on machine, leads, and lamps.	Speed of machine.
2	1·28 horse-power	1,150 revolutions per minute.
4	2·27 ,,	
6	3·60 ,,	
8	4·25 ,,	

The average illuminating power of the lamps was 323 standard candles (actual) during these measurements.

Similar measurements with ten Jablochkoff lamps and upwards in the circuit were made with the aid of a 20 (nominal) horse-power steam-engine, which enabled a greater velocity of rotation to be steadily maintained.

When ten lamps were in circuit, the machine being driven at 1,226 revolutions per minute, the engine-power expended in machine, leads, and lamps was 5·65 horse-power, the average illuminating power per lamp being 430 standard candles (actual) or an effective equivalent of 762 standard candles (actual) per horse-power expended, which is as high as can be expected for a small machine.

The light given by the lamps was remarkably steady, and the carbon rods were consumed very uniformly.

At the desire of the inventors as many as 16 Jablochkoff lamps were at one time introduced into the circuit and burnt steadily; while 14 lamps were burning the average illuminating power was found to be 388 standard candles per lamp. The machine after being at work for two hours did not show any signs of heating, so long as the number of lamps did not exceed 10. But when 16 lamps were sustained the stationary induced magnets became after awhile heated, the rest of the machine and the moving bobbins remaining cold. I conclude from this that not more than 12 Jablochkoff lamps, each giving a light of about 400 standard candles (actual) could be safely worked continuously by this little machine.

The commutator which directs the currents from one of the stationary electro-magnets into the magnetising circuit, works against the brushes perfectly free from sparks.

In the foregoing tests the coils of the machine and the lamps in circuit were connected up in series.

The terminals of the machine are, however, arranged so that the current of each induced bobbin may, if required, be connected so as to actuate a separate and independent lamp circuit.

A very ingenious arrangement is employed for short-circuiting each of the induced bobbins by the armature of a small electro-magnet which falls upon the terminal blocks in the event of a rupture of the outer lamp circuit.

In point of cost I should say that this machine would certainly be the cheapest I have seen capable of keeping an equal number of lamps in action.

Yours faithfully,

(Signed) ROBERT SABINE.

7, Great Winchester Street Buildings,
London, E.C.
5th December, 1882.

CHERTEMPS' DYNAMO MACHINES.

Dear Sir,—I have, at your request, tested two of the Chertemps machines which you have at Charles Street, Hatton Garden.

In reply to the questions asked in your letter to me of the 24th November, I beg to say that:—

1. I find the smallest machine (alternating current) keeps twenty Edison A 16-candle lamps incandescent at an expenditure of about 2 horse-power as indicated by M. Morin's dynamometer which is placed between the steam-engine and the machine.

The maximum number of lamps which I saw in circuit at one time was twenty-five, which number was then reduced by five at a time. The horse-power indicated by the dynamometer fell each time proportionally to the number of lamps removed from the circuit.

2. The medium-sized machine, when giving alternate currents with its induced bobbins parallel, was put in circuit with 52 Edison A lamps, which were kept incandescent at an average of 17·5 candles with an expenditure of 6·2 horse-power indicated by the dynamometer. The machine was afterwards connected up so as to give continuous current, the same number of lamps being kept incandescent at an average of 15·1 candles per lamp, while the indicated horse-power was 5·1, showing that in so far as lighting power goes circuits with alternate and continuous currents generated by the same machine give much the same result. In each instance over 80 per cent. of the power given to the dynamo machine was accounted for electrically, and over 65 per cent. was accounted for in the lamps alone.

3. The same machine, with its induced bobbins in series and giving alternate currents, was then connected with and kept in action ten Jablochkoff lamps, also in series, at a total expenditure of 4·9 horse-power indicated by the dynamometer as being given to the dynamo machine. The number of lamps was changed by two at a time and, the difference of the power given to the machine being observed at the dynamometer, it was seen that the power employed was always proportional to the number of lamps in circuit, the machine regulating this automatically. When maintaining the Jablochkoff lamps about 80 per cent. of the power given to the dynamo was accounted for electrically, and with over four lamps in circuit about 65 per cent. was accounted for in the lamps alone.

I consider that, having regard to their size and weight, the efficiency of these dynamo machines both for arc and incandescent lamps is very satisfactory.

I enclose the details of the tests made with the larger of the two machines.

Yours faithfully,

ROBERT SABINE.

R. Applegarth, Esq.,
Mansion House Chambers, E.C.

Chertemps' (Medium-sized) Machine tested with 52 Edison A Lamps (French-made) connected Parallel with Short Leads.

	Alternate Current.	Continuous Current.
Main Circuit (external):—		
Current per lamp	0·68*a*	0·66*a*
,, for 52 lamps, c	35·4*a*	31·3*a*
Potential difference, e	85v	83v
Horse-power accounted for in 52 lamps... ... $\frac{c\,e}{746} = w$ ...	4·03	3·48
Main Circuit (internal):—		
Current (as before), c	35·4*a*	31·3*a*
Resistance of 5 bobbins parallel, r ...	0·3ω	0·3ω
Horse-power accounted for in internal wire ... $\frac{r\,c^2}{746} = w_1$	0·50	0·39
Magnetising Circuit:—		
Current in magnetising circuit, c_1 ...	6·5*a*	6·5*a*
Resistance in magnetising circuit, r_1 ...	7·4ω	7·4ω
Horse-power accounted for in this amount ... $\frac{r_1\,c_1^2}{746} = w_2$	0·42	0·42
Speed of dynamo, rev. per min.	1,180	1,174
Pull on dynamometer, k	49 kilog.	45 kilog.
Speed of dynamometer, rev. per min., s ...	662	648
Indicated horse-power $3{\cdot}21 \times 10^{-4}\, s\,(k-20) = W$	6·2	5·1
Horse-power accounted for electrically, $(w \times w_1 \times w_2)$	4·95	4·29
Proportion of horse-power electrically accounted for $\frac{w \times w_1 \times w_2}{W}$	0·80	0·84
Proportion of horse-power accounted for in lamps alone ... ... $\frac{w}{W}$	0·65	0·68
Horizontal (front) candle-power of one lamp (average)	17·5	15·1

Chertemps' (Medium-sized) Dynamo Machine tested with Jablochkoff Candles connected in Series.

Number of lamps in circuit, n ...	10	8	6	4	2
I. Main Circuit.					
Current in ampères, c	5·5	5·5	5·3	5·0	5·0
Internal resistance in ohms, r ...	7·3	7·3	7·3	7·3	7·3
Horse-power accounted for internally $\frac{c^2 r}{746} = w$	0·30	0·30	0·27	0·24	0·24
External potential-difference of lamps, volts, E	430	344	258	168	88
Horse-power accounted for in lamps $\frac{E c}{746} = w_1$	3·16	2·53	1·93	1·15	0·60
II. Magnetising (Field) Circuit.					
Current (ampères), c_1	5·4	5·0	4·6	4·1	3·7
Resistance of wire (ohms), r_1 ...	7·4	7·4	7·4	7·4	7·4
Horse-power accounted for in field circuit $\frac{c_1^2 r_1}{746} = w_2$	0·29	0·25	0·21	0·17	0·14
Speed of dynamo	1,242	1,230	1,236	1,260	1,218
Pull on dynamometer in kilog., k	42	36	32	28	24
Speed of dynamometer, revolutions per minute, s	665	666	678	676	678
Indicated horse-power, $3{\cdot}21 \times 10^{-4}\, s\,(k-19) = W$	4·9	3·7	3·0	2·0	1·2
Horse-power electrically accounted for, $w \times w_1 \times w_2$	3·75	3·08	2·41	1·56	0·98
Proportion of horse-power electrically accounted for	0·77	0·83	0·81	0·78	0·81
Proportion of horse-power electrically accounted for in lamps ...	0·64	0·68	0·64	0·57	0·50
Horizontal front candle-power of one lamp*	289	334	321	308	279

On Tuesday evening last we had an opportunity of seeing two of these alternating current machines in action at 35, Charles Street, Hatton Garden, where they were shown under the auspices of Messrs. Applegarth and Wills. The small machine was joined up with 20 incandescence lamps and Mr. Applegarth disconnected them one by one until only a single lamp was left, which, however, did not increase perceptibly in brilliancy, although the machine was running at the same speed all the time. This however is easily understood in such a construction of machine, the lamps being connected in multiple arc. That which is not so easy to explain is the proportionate automatic regulation of the machine for work to be done when connected up with Jablochkoff candles in series. It would be a very interesting matter to construct a Dandeu-Chertemps machine weighing, say, 12 cwt. complete and compare its efficiency with that of the recently exhibited "Ferranti." The machine which kept the 52 Edison lamps in action is very small and its weight cannot be much, but we could not get any definite information on this point. In regard to Mr. Sabine's tests we can only draw attention to the fact that the Morin dynamometer may or may not have given accurate results. However, we have no reason to doubt its correctness and only draw attention to it as a *possible* item of uncertainty. As far as we can judge at present the Dandeu-Chertemps system, the principle of which is of course common to many machines, appears to have a promising future before it and as far as merit goes should command success.

Personal.—It may interest our readers to know that Messrs. H. and E. J. Dale, the well-known electrical instrument makers, have succeeded to the business so long carried on by Mr. F. J. Cox, of 26, Ludgate Hill. This extensive addition to their already considerable premises will enable them to keep in stock, ready for immediate use, the largest collection of electrical apparatus in London. In addition to this they will keep a most complete assortment of photographic, optical, chemical, &c., materials and appliances. The Messrs. Dale have now three establishments: the one above-mentioned, 3a and 4, Little Britain, and 9, Kirby Street, E.C. They have established a dynamo-electric machine factory at the latter place. Messrs. Dale notify that with the resources now at their command they intend to keep in the forefront of scientific industry. We wish them every success.

* The carbons used in these measurements were apparently of inferior quality.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," Electrical Review, at above address.

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CORRESPONDENCE.

THE PATENT ELECTRIC GAS IGNITING COMPANY.

To the Editors of The Electrical Review.

Dear Sirs,—While acknowledging the public spirit and the laudable motive which has led you to the criticisms in your issue of the 9th inst. upon the prospectus of the "Patent Electric Gas Igniting Company, Limited," I cannot help thinking that these are based solely upon your perusal of the prospectus, and not upon an examination of the different apparatus and patents acquired by the company. You will agree with me that on the value of these alone will depend the correctness of the anticipations set forth in the prospectus, and whether the statements contained therein are exaggerated or not.

From intimate knowledge of the construction of the electric gas lighter and experience of its appreciation by the public hitherto, I can substantiate the truthfulness of the advantages enumerated, and can see no reason to doubt the general soundness of the predicted success so confidently stated.

You yourself acknowledge that many others have tried to produce contrivances for gas lighting by electricity, which goes to prove the existence of a public want in that direction, and your principal strictures appear to arise from the hitherto lack of success of such attempts. Now I can affirm that Clarke's patent gas lighter is in every way, scientifically and commercially, a success, and fulfils completely all requirements, and as a proof of this, I may say over 10,000 have, within a very short time, been sold in the Manchester district alone, and that the demand exceeds the supply by as many thousands more. As the lighter is already being extensively sold, your readers have an opportunity of examining its construction for themselves, therefore I need not enter into detail, but referring to your statement, which I fully endorse, regarding the form of the battery and coil, I am not aware of any possible combination of existing batteries and coils that could be used for the same purpose. However, the company is not dependent on the manufacture of these lighters alone, but the battery itself and the particular construction of the coil are applicable and useful for so many different electrical purposes that I con-

fidently anticipate unprecedented results for the company from the manufacture and sale of these two items solely.

On the value of the battery as such the company have the most flattering testimony from such eminent electrical authorities as Sir W. Thomson, Messrs. Preece, De La Rue, &c., it being small, constant, hermetically sealed, portable, and producing no internal action when not in circuit, therefore well adapted for telephones, bells, medical and testing work, &c., and facilitating the more general adoption of electrical appliances by the public.

The coil, from its exactness and cheapness, will recommend itself to the notice of electrical instrument makers.

As to the chances of profits arising to the company from the sale of concessions and foreign patents, if what I have stated above is true, the business in England must, with good management, succeed, and then it cannot be difficult to dispose of these to the advantage of the original shareholders. While, for the company itself, I can say from personal acquaintance that with such a directorate and manager, whom I have found to be thorough men of business and gentlemen far too scrupulous to insert in a prospectus anything not entirely in accord with their conviction, good management is assured.

So convinced am I of this that I have identified myself with them both as a shareholder and as the chief contractor for the general sale of their manufactures, and I shall always be happy to give all information regarding these to any one interested.

Feeling sure that you would not willingly impede, but rather are eager to promote, the general adoption of electricity to all useful purposes, I trust you will not consider this letter too great an encroachment upon your valuable space.

Thanking you, I am, dear Sirs,

Yours truly,

G. BINSWANGER.

29, Aldermanbury, E.C., *December 11th*, 1882.

[In reply to our correspondent's arguments in favour of the above company, we may say that we have examined one of Clarke's patent gas igniters, and we think that as far as its purpose goes it is quite a success—indeed, we have never seen anything so good before. We have yet to learn that the conviction of a directorate necessarily means the success of a company's operations; in fact, we have too many proofs to the contrary. We should be pleased to feel that the sanguine anticipations of Mr. Binswanger would be carried out, but we do not think it incumbent upon us to withdraw any of the remarks contained in our article or to comment further on the matter.—EDS. ELEC. REV.]

THE B. T. K. SYSTEM OF ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I should be obliged if you or one of your many correspondents would assist me by explaining the following difficulty which occurs to me respecting the B. T. K. system of incandescent electric lighting:—We know that incandescent lighting requires a current of low tension and great quantity. Then how is it that in the above system a Brush arc machine, producing a current of high tension and low quantity, is used to charge a reservoir composed of secondary batteries connected in series? Does the current undergo a change of nature in course of accumulation, and the charge emitted possess the properties of an incandescent current? It appears to me necessary that it should do so in order to produce incandescence without breakage. If so, how, and by what agency?

Yours truly,

December 7th, 1882. R. A.

[To charge secondary batteries in series we employ a dynamo-electric machine of greater electromotive force than the combined secondary cells possess when fully charged. For instance, if we had to charge 150 cells in series, we should make use of a machine having an electromotive force of considerably more than 300 volts, as each cell represents something over 2 volts when charged fully. Our correspondent will quite understand that the charging battery or machine must be more powerful than the receiver, otherwise in a certain time the latter would have an equal electromotive force with the former, and would, therefore, oppose any further charge. There is no such term as an "incandescent current." The amount of current passing in any circuit depends upon the resistance of that circuit and the electromotive force of the generator. If "R. A." connected up 20 Swan lamps (of the 41 volt and 18 candle-power type) in multiple arc, he would require a machine wound to give 41 volts or a trifle more, and a current of 26 ampères, which divides in 20 parts through an external resistance (lamps) of 1·57 ohms. On the other hand he might connect the 20 lamps up in series, and it would then be necessary to wind a machine to give 820 volts, or thereabouts, electromotive force, and a current of 1·3 ampères through an external resistance (lamps) of 630 ohms. The lighting effect would be the same in both cases.—EDS. ELEC. REV.]

THE BRUSH COMPANIES AND THE LANE-FOX LAMP.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I think your article in this day's Review on "The Brush Companies and the Lane-Fox Lamp" is a very fair statement of the case. The position of the shareholders in some of those companies I take to be this:—

We ventured on the faith of plausible prospectuses to invest in property we did not understand, and we paid the prospectus-makers, who did understand it, large sums for certain concessions. So far, good. We made a bad bargain and we must be prepared to abide by it; but in due time it turns out that the other side have sold more than they are able to convey. Are we not then fairly justified in reconsidering the transaction and rescinding the entire contract? If I contract to purchase two houses for one sum, but find the title to one of them is bad, I cannot be compelled to take the other, though I may claim damages for the breach of contract.

With regard to the tabular statement annexed to your article and "compiled from official returns at Somerset House," I would point out that as regards the Yorkshire Brush Company it is very misleading. The capital issued is not £200,000, as only 61,638 two pound shares have been issued, including 25,000 to the vendors "considered as paid." This was admitted by the chairman at the meeting on November 15th, reported in the ELECTRICAL REVIEW of the 18th. Again I find under "calls paid" £122,943 10s., but this also includes shares considered as paid, for the chairman admitted (*vide* your report) that after settlement with the vendors there was only a capital of £23,000 to go on with.

It appears to me that "The Companies Acts" require further amendment in many particulars. Is it not absurd to publish official returns of "capital issued" as so many hundred thousand pounds, simply because that amount has been offered to the public?

Yours obediently,

A SHAREHOLDER.

December 9th, 1882.

THE ELECTRIC LIGHTING ACT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—The remarks lately made by Mr. Chamberlain as to the Board of Trade's action touching Electric Light are certainly in favour of companies desirous of showing what they can do, enabling them to spend their (in many cases) too easily obtained capital without parish assistance, in the shape of a contract to light the principal thoroughfares of the district. Most of the new light companies will labour under considerable disadvantages, and I would strongly advocate their not acting hostile to, but running concomitant with the vestry authorities. There is no doubt that in the event of several companies applying to a parish for "permission," those who have to decide cannot fail to be (using a word most applicable at this time) fogged. Again, to cater for the illumination of an entire district may, in many instances, be more than the funds of a company can well stand, looking to the fact that they are in all probability carrying on good work elsewhere. Now would it not be better for the local authorities to closely scrutinise the systems, making up their minds to adopt for their own lighting, say, one system in the wider and

larger streets of the parish; another mode, where the areas are spacious and extensive; and a third, if practicable, where lanes and narrow streets have to be dealt with, in each and every case, allowing the company installed to provide private lighting in the section of the parish where they have laid their cables? It might happen that the proprietors of a system selected by a vestry for adoption in a part of the district might decline to entertain the proposal, in which case the authorities would have to select another and the company reserve their money for what they might consider a better installation.

Taking a survey of the various systems now before us and under what circumstances the best of them would be the proper light in the right place, I might be allowed to suggest, for large open spaces and lofty railway stations, if not too expensive, "Siemens," not, however, pitching the poles as high as in the late City trials; if the price forbids, "Brockie," if he will behave better and not hum so much.

For long roads where good lighting is required, appearance or uniformity not being a desideratum, perhaps no better lamp than "Weston."

For streets where uniformity and neat and trim appearance are required, "Jablochkoff"; this also, I may say all round, is for every purpose, in or out of doors, the best "arc" lamp.

For narrow streets and lanes, having the lamps swung across the streets, fixed to a bar placed high up, a "Pilsen" or a "Brush" might be employed. I have thus very roughly gone over a few of the best arc lamps, leaving entirely out of account incandescent globlets: they are really, in street or public lighting, not so good as gas; only in small rooms do they score. For outside illumination, which we require to be of a better description than at present, the use of an incandescent lamp is *not* an improvement. Most of the arc companies above-named, in the portions of the parishes or districts allotted to them, would be able, no doubt, to introduce the incandescent lamp they thought best suited; by some such plan capital would, I think, be saved; no unnecessary laying of wires need take place, and the vestries would have an opportunity, if they had more than one system installed in their district, of judging which did the work best, and which was most reasonable. The term of years at first accorded, and it ought not to be less than three, having expired, they would be enabled to decide which for the future was to be the "parish lamp."

Before concluding, a few words touching fogs.

This, in the future of electric lighting, is a serious question. The ever-handy servant, gas, has only to be turned on, and in foggy weather our darkened residences, or places of business, become bright and cheery. With electric light it is a more difficult matter. Steam-engines and dynamos have to be set in motion. True, if accumulators are ever perfected, a store of electricity will be to hand, to turn on when required. In these, our seemingly ever-increasing darkening winter days, there is to be considered what system in lighting by the new method is best adapted for fog. In most the blue or yellow ray predominates. Such in thick fogs are hardly visible; the red ray alone permeates the thick and cloudy atmosphere, and perhaps for such "Jablochkoff" stands best adapted. Many months ago, when fogs hung thick on the banks of the Thames, and when other systems were in the streets, hardly more discernible than gas, I have, in my rambles, often noticed the lamps on the Embankment clear and distinct at over fifty yards. The gas lights could not be seen until at the lamp-post one had arrived, while standing at the foot of a Jablochkoff lamp, one distinctly saw the next, with a "halo" of the one succeeding. Perhaps some of your able scientific correspondents will give us their views on this most interesting subject.

In the use of electricity as a lighting medium in comparatively clear weather we go on steadily improving. Still we have, in this our fog-girt isle, yet to discover by what means, or by what chemical introduced into the electrodes, the proper ray can be developed, so as to show through fog, thereby assisting us in lighting when necessary our streets, and protecting our noble sailors when in foggy weather approaching our iron-bound coasts.

ELECTRON.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—No doubt you are still desirous of further opinions of students respecting the results to themselves of the lectures in electricity at the City and Guilds of London Institute. I regret that my experience should conform so closely to that of "F. W. F." and "Sea Boots," and I consider that the tone of Mr. Cockburn's answer in yours of the 2nd inst. confirms "Sea Boots'" complaints as to the courtesy (?) of the assistants.

No doubt in the present crowded state of the laboratory it is difficult to find room and patience for all; nevertheless, I think that the insinuation as to the method of relief put forward by Mr. Cockburn in the last sentence of his letter comes with questionable taste from a paid official in a subordinate position, and is deserving of resentment by the students, and ought to be rebuked by his superiors.

Much depends on the attention given by the Professor and the Demonstrators in the laboratory, but it seems to me the want of this, and the almost entire absence of organisation and system, and not the overcrowding, are the cause of the admitted failure of the laboratory experiments, for I have noticed the same difficulties when only a small number of students happened to be present.

The lectures themselves I feel a reluctance to criticise but my own opinion is that the whole cause suffers for want of a well-considered syllabus at the outset, and the lectures individually appear deficient in careful preparation, but above all I question whether the professor pays sufficient attention to the different states of advancement which must exist in so large a class.

This is noticeable when at rare intervals, after filling the blackboard with figures and formulæ, he inquires if all have understood him. The hesitancy in replying to this inquiry (often not one of the hundred present ventures to put a question or seeks an explanation) shows either that all thoroughly understand it, or that the majority have failed to grasp the gist of the Professor's remark. I should like to take a poll of my fellow students as to which is the correct interpretation of their silence. Let us hope that when the larger building is ready improvements in organisation may be inaugurated which will materially reduce these difficulties as well to the Professor and staff as to the students; otherwise I fear that the "many thousands of pounds" alluded to by Mr. Cockburn will fail to yield the full return expected by the givers.

I would, lastly, offer the suggestions that the new building should be provided with an efficient reference library of standard works and the laboratory amply furnished for the use of the students, with models of telegraph and telephone instruments, and of the different parts of dynamos and lamps, of which now there is a great paucity.

Yours faithfully,
ONE WHO WISHES TO LEARN.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Having read with interest the information in your journal concerning electrical engineering classes in London, I venture to ask you for any information you could give me concerning the School of Telegraphy and Electrical Engineering (Prince's Street, Hanover Square). I write specially on behalf of a friend who is thinking of entering as a student. According to their advertisements and prospectus, this school would appear to be all that could be desired, but I should be much obliged if among your subscribers any former student would kindly give his experience, especially concerning the questions so aptly put in your issue of November 18th.

I take this opportunity of writing to you to ask if you could give me information concerning the method or methods of rendering a watch unaffected by magnetic influence; perhaps you could quote some back number of the ELECTRICAL REVIEW where I should find this. Does it consist in the substitution of some non-magnetic metal for the steel springs and bearings? I enclose my card, and

Remain, Sirs, yours truly,
December 12th, 1882. OLD SUBSCRIBER.

[Our correspondent's surmise in his last paragraph is, we believe, correct.—EDS. ELEC. REV.]

THE TELEPHONE PATENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—The enclosed correspondence may be of interest to the public.

Messrs. J. T. Gent & Co., on the receipt of the following letter from the solicitors of the United Telephone Company, were released by me from their contract to make the Lockwood-Bartlett telephones, and at once cancelled their orders for materials to make them, because I was unwilling that their business should be injured by any action the United Telephone Company might take in their attempt to prevent the public from having the benefit which must arise from competition. The Lockwood-Bartlett telephone will be offered to the public by the Molecular Telephone Company of New York, and that company, with a fully paid-up capital of £200,000, will be ready and able to defend its patent rights. Yours truly,

December 14th, 1882. W. C. BARNEY.

From WATERHOUSE and WINTERBOTHAM, Solicitors.
1, New Court, Carey Street, Lincoln's Inn, W.C.
29th November, 1882.

GENTLEMEN,—Your letter of the 24th inst. addressed to the United Company has been handed to us to reply to.

We have not seen the telephone which you term the "Lockwood-Bartlett," but if it is a magneto instrument operating upon the principle of Bell's instruments as we are given to understand, it is, in our opinion, an infringement of our clients' patent rights.

We have never seen a carbon transmitter operating successfully without a diaphragm, and we would refer you to the judgment both of Lord McLaren in the case of the United Telephone Co. *v.* McLean, and of Mr. Justice Fry in the case of the United Telephone Co. *v.* Harrison, Cox-Walker & Co., as showing what, in the view of the court, constitutes a diaphragm.

We are not, therefore, prepared to admit that this instrument is outside the Edison patent, nor, indeed, that it would be so even if it had no diaphragm at all.

Our clients will take such proceedings as they may be advised in the event of the continued sale of these instruments.

We are, gentlemen, yours obediently,
WATERHOUSE AND WINTERBOTHAM.

Messrs. J. T. GENT & Co.
Faraday Works, Leicester.

7, BRIGHTON VILLAS, PRINCESS STREET,
LEICESTER, *December 2nd*, 1882.

GENTLEMEN,—Your letter of 29th ult., addressed to Messrs. J. T. Gent & Co., has been handed to me. A more extraordinary document emanating from gentlemen "learned in the law" has never till now been my lot to read; you write "we have not seen the telephone Lockwood-Bartlett," and from your own imagination or from hearsay, you build up a hypothetical case, and then you have the cool assurance to use threats against Messrs. J. T. Gent & Co., manufacturers, under contract with the Molecular Telephone Company of New York, to make the very excellent Lockwood-Bartlett telephones. Your combined legal minds have no doubt suggested to your clients the danger they would incur if they should write such a threat, and you, their legal advisers, prepare a shield for your own justification by qualifying your threat with that important little word "if."

Your opinion that the Lockwood-Bartlett instrument is an infringement of Bell's instrument may be highly valued by your clients, but as you admit you have not seen the instrument of Lockwood-Bartlett, I hope you will not think me discourteous when I say your opinion has no weight whatever with me, nor do I believe it can have any weight with any one.

In order that you may examine the excellent Lockwood-Bartlett telephone, I have requested Messrs. J. T. Gent & Co. to send you one of these telephones.

These conscientious gentlemen, before they agreed to manufacture the L. and B. telephones, took great pains to examine critically the construction of this instrument, and to compare it with that of the Bell telephone.

They had before them the opinions of Cromwell F. Varley, F.R.S., and of Sir Charles T. Bright; both of these eminent electricians gave opinions that it is not an infringement of Bell's patent; they had also the description of Bell's invention by Sir William Thomson, given under oath, in the suit of the United Telephone Company *v.* Harrison, Cox-Walker & Co., to which case you refer Messrs. J. T. Gent & Co., which description is in the following words: "the most important part of the new invention is the fixing of the vibrating iron plate all round its edge, that is a most important part, perhaps the most important part of all;" "the disc held at one point of the edge was made known before the date of this patent, and the new invention included the substitution for the disc held at one point, of a disc held all round its edge;" they, however, mainly relied upon the description of Bell's invention given by Mr. Justice Fry in his clear judgment, which is in these words: "Bell's invention, as claimed by him, and as I understand it, consists of a horse-shoe magnet, the ends of which are brought into the circuit by means of coils of wire, and in front of which is a metallic plate capable of inductive action, placed at right angles to the length of the magnet, resting, as regards its circumference, on the wooden case."

These gentlemen did not find in the Lockwood-Bartlett a *metallic plate* [illegible] *inductive action* placed at right angles to the length of the magnet resting, as regards its circumference, on the wooden case, but they did find a *free tongue*, as used by Reis, and as used by Bell in his famous Glasgow receiver, and as described by Bell in his United States patent of March 7, 1876, and also in Bell's English patent of December 9, 1876. I refer to the telephonic apparatus with the gold-beater's skin, which is represented in the drawings of Bell's patent, figure 19. Unfortunately for your clients that description was published in England prior to December 9, 1876, and therefore it became necessary, in order to save his patent, to disclaim that device by a disclaimer filed on the February 13, 1878; and also the Glasgow receiver, which was never patented by Bell in England, was made public prior to the December 9, 1876.

The right to use a *free tongue* in a telephonic instrument *in combination* with an *electro-magnet* is, therefore, unquestionable. Mr. Justice Fry in his judgment used the words, "it appears to me to be plain that the armature in Reis's receiver was not a disc at all, it was not a plate at all, and there is nothing in the Reis which can be considered to have been an anticipation of the armature of the description indicated in Bell's patents;" hence it follows that the Bell patent does not cover a *tongue armature*.

In reply to your hypothesis that a magneto instrument, operating upon the *principle* of Bell's instrument, is, in your opinion, an infringement of your client's patent, I must confess that I am ignorant of that part of the Patent law which allows a *principle* to be subject-matter for a patent, and I shall be pleased if you will enlighten me on this point. It seems to me that it was unnecessary for you to use a *hypothetical case* upon which to make your threats against Messrs. J. T. Gent & Co., as you could have obtained a copy of Lockwood-Bartlett's patent from the Patent office, or from the general manager of the United Telephone Company, to whom I gave a copy in March, 1881, and who was well acquainted with the Lockwood-Bartlett receiver, one of which he tested in my presence at the offices of the company on the 16th March, 1881, and by his instructions it was tested by his employés, on several occasions, at the company's offices in Chancery Lane and Westminster, with excellent results.

Although I have no interest whatever in the excellent transmitter of Messrs. J. T. Gent & Co., you will pardon me, I hope, if I submit a few remarks upon that part of your letter wherein you write, "We have never seen a carbon transmitter operating successfully without a diaphragm." Surely the fact that *you* have never seen such a transmitter is no evidence that no such transmitter is in existence. Now, in order to enlighten you on this point, Messrs. J. T. Gent & Co. will send you one of their transmitters, wherein you will *not* find a diaphragm, nor the semblance of one, as is clearly proved by the judgment of Lord McLaren and Mr. Justice Fry. You will find that this transmitter *without* a *diaphragm* is a remarkably good one, and you then *perhaps* may be convinced that it is outside the Edison patent, although I cannot expect that you will admit it, as you write, "you are not prepared to admit it even if it had no diaphragm at all." Here comes in what you must excuse me for terming the ridiculous part of your letter.

Edison's single claim left out of his original thirty odd claims is for "the combination with a diaphragm, or tympan of electric tension-regulators substantially as hereinbefore described." These are the essential parts of his invention, the *combination* of the two parts are covered by the patent, but the use of either of them alone certainly is outside the patent.

It is indisputable that the specifications must describe the nature of the invention in an intelligible manner, so that a person of ordinary acquaintance with the subject-matter could understand it.

I now put it to you, could any mechanic skilled in the construction of telephones make a Lockwood-Bartlett receiver from the description of Bell's telephone given in the specification of the patent, or could a mechanic make a Bell telephone from the description of the Lockwood-Bartlett telephone as given in his patent, No. 2,419, June 10, 1880? The Molecular Telephone Company of New York, who are the owners of the Lockwood and Bartlett patent, will take such proceedings as they may be advised to protect their patent rights, as well from *libel* as from infringement, and also to protect their manufacturers from intimidation by threats or otherwise.

I am yours obediently,
W. C. BARNEY,
Agent for the Molecular Telephone Company of New York.

Messrs. WATERHOUSE & WINTERBOTHAM, Solicitors,
1, New Court, Carey Street, London.

POPULAR LECTURE ON ELECTRIC LIGHTING AND THE ELECTRIC TRANSMISSION OF POWER.—Mr. A. Reckenzaun, C.E., lectured on Wednesday evening before a crowded house in the new and spacious Limehouse Town Hall. After some historical remarks the production of electric currents by wire coils in magnetic fields was illustrated; and various forms of arc and incandescent lamps were shown in operation. The main feature of the evening, however, was the Sellon-Volckmar accumulator, which gave remarkable proofs of its utility. One set of cells, 30 in number, served for the arc lamps, all kinds of incandescent lamps, and finally for driving several motors; the collection of small motors in action consisted of a Griscom, the Howe motors, De Méritens' electro-motors, C. type, and a motor of Mr. Reckenzaun's own design. Mr. Percy Mills assisted in the experiments, and the proceedings were very successful and highly ap[illegible] an attentive audience. It may be ment[illegible] lecture was arranged by the Limehouse [illegible] small body of energetic men.

[illegible] they are [illegible] where. Now [illegible] orities to closely [illegible] their minds to adopt [illegible] system in the wider and

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

ELECTRIC LIGHTING.—A very large number of local authorities have applied for licences or provisional orders under the Electric Lighting Act, and it has been stated that in many cases the application is prompted, not so much by the desire of lighting their respective districts themselves, as of preventing the electric light companies from doing so; and it will be remembered that one of the leading rules of the Board of Trade, under section 5 of the Act (rule 2), is to the effect that local authorities are to have the preference in cases where "any other authority, company, or person" may compete with them for the grant of a provisional order. This preference, however, is restricted to the application, and when the application is once granted neither the Act nor any rule yet made provide for any particular privileges of a local authority in supplying the light, nor any exemption from the heavy burdens which may be imposed by the Board of Trade under section 6. This section provides that the undertakers shall be subject to such regulations and conditions as may be inserted in any licence or provisional order as to (*inter alia*) the compulsory supply of electricity, the securing a regular and efficient supply, the limitation of the price to be charged, and the enforcement of the due performance of the duties of the undertakers in relation to the supply of electricity by the imposition of penalties or otherwise. The corporations appear at last to have become alive to the awkward position in which they stand, and the deputation which waited on Mr. Chamberlain recently was the result. The deputation did not receive much consolation from their interview, and it is obvious that the corporations will have to consider carefully the course which they should take. We cannot find in the rules yet issued any provision for withdrawing an application, but we presume that this can be done by any applicant at any time; and perhaps, on considering the difficulties with which they will have to contend at the expense of their constituents, we may hear before long of pressure being put upon some local authorities to leave the field to be fought for by competing private companies. On the other hand, though the Act contains nothing to authorise, it seems to contain nothing to prevent, the Board of Trade from granting licences and orders with less onerous conditions to the local authorities than to the companies; but whether that board, which is almost all-powerful under the Act, will be inclined to do so, or whether it will consider that "special circumstances," within the meaning of rule 2, render the preference of the application of the local authority "inexpedient," are matters on which we forbear to speculate.—*Solicitors Journal.*

THE Stonelaw Skating Pond, Rutherglen, was the scene of considerable excitement on Saturday evening last, through the unexpected lighting of the pond by an arc lamp supplied by Mr. Akester, of the Bridgeton Universal Electric Company. The experiment was successful and the vivacity of the skaters unbounded.

THE Maxim-Weston Company have completed a large installation near Durham. Last week two contracts for installations in Scotland and Ireland were secured. The number of orders for their Weston arc lamps is such that they have had to increase their staff. The demand for the Maxim lamp is said to be steadily increasing.

PRINCIPAL VIRIAMU JONES, Firth College, Sheffield, delivered before a large audience in the Kinnaird College, Dundee, on Friday se'nnight, an interesting lecture on the electric light. The hall was lighted by electricity.

[illegible] extensive railway carriage works of Messrs. Brown, [illegible]alls and Company (Limited), at Saltley, near Birmingham, [illegible]nding over an area of 10 acres, are now lighted by [illegible] The lighting is effected by means of 40 Brush arc lights of 2,000 candle-power each, driven by one of Fowler's 16 nominal horse-power semi-portable engines, the work having been carried out by the Birmingham and Warwickshire Brush Electric Light and Motive Power Company (Limited). The result is said to be very satisfactory both as regards efficiency and economy.

MR. N. STEVENSON, Manchester, uses a small Swan incandescent lamp to illuminate the cavity of the mouth in his dental operations. It is fitted into a vulcanite cup, which acts as a prop to keep the jaws apart.

THE Dunfermline Town Council have agreed to co-operate with other burghs throughout Scotland in a joint representation to the Board of Trade, or in such action as may be deemed advisable in relation to the Electric Lighting Act and the applications by private companies for Provisional Orders.

AT a meeting of the Montrose Police Commission on Monday, a motion was made that the Commission fix upon the Brush Electric Light Company to supply the town with the electric light. After an animated discussion, it was decided to consider the motion at next monthly meeting, and that prior to that day the board should meet in committee and consider the matter.

THE Stirling Police Commissioners have replied to a letter from the Brush Electric Light Company asking the same terms for supplying Stirling with electricity as had been granted for the burghs of Aberdeen and Dundee, that they are to take no action in regard to the electric light "at its present experimental stage."

WE have received from the Edison Electric Light Company information to the effect that during the recent extraordinary fog the company, recognising the necessity for distributing the light to their customers without intermission, maintained their dynamos in action at Holborn Viaduct for a continuous period of 64 hours without stopping. Starting at three o'clock on Saturday afternoon, December the 9th, the dynamos ran without ceasing during Saturday, Sunday, Monday, and Monday night, stopping at eight o'clock on Tuesday morning, December the 12th. This had not before been done in England, and was not accomplished by the other electric light companies in the city.

The current was supplied from two large dynamos which are used alternately, and during this long run the current was switched off from one dynamo on to the other, or back again five times by means of a peculiar switch which enables this to be done without in the least degree interrupting the lighting. The incandescent lamps in the shops on Holborn Viaduct and in the street were thus maintained during the whole of this time.

The company have, therefore, demonstrated not only their ability to supply electric lighting on a large scale as they have been doing for the past nine months, during the hours of usual darkness, but to maintain constant electrical pressure in the mains day and night and to comply completely with the condition of continuity of lighting, which is requisite in order that the problem of distributing electricity for lighting and other purposes may be considered solved.

IN Sheffield, the premises of Mr. Arthur Davy, provision merchant, are illuminated by 120 incandescence lamps. The arrangements have all been carried out by Messrs. Tasker, Sons & Co., with great success.

AN indignation meeting was held in Walworth (London) on Tuesday evening, the 5th inst., to protest against the determination of the Newington Vestry to undertake the supply of electricity. A long and animated discussion took place, and it was resolved that a committee be appointed to take the necessary steps for opposing the Vestry.

IN the Bermondsey Vestry the Clerk reported that the Metropolitan (Brush) Electric Light and Power Company had given notice of their intention to apply to the Board of Trade for a Provisional Order to authorise that company to light the district by electricity.

AT the meeting of the St. Olave's Board of Works the Electric Light Committee reported that the Metropolitan (Brush) Electric Light and Power Company had deposited plans for a Provisional Order to light the district of St. Olave's and the parishes of Bermondsey and Rotherhithe;

and they (the committee) recommended that delegates be invited from the other parishes to a conference, and that notice of opposition to the application be given. The recommendation was adopted on the motion of Mr. Scovell, who remarked that the committee did not wish to forestall the decision of the board, but merely wished to retain the option of opposing the application.

The Canterbury Town Council met on Wednesday to consider the means to be adopted by them in connection with the application by three companies for Provisional Orders authorising them to establish works and lay down the necessary apparatus for supplying Canterbury with the electric light. The meeting declared itself to be unanimously in favour of the insertion of clauses for the protection of the interests of the city in the Provisional Order issued by the Board of Trade.

In London a meeting of the Commissioners of Sewers has been called for Tuesday, January 9th, 1883, to consider the following motion by Mr. Moore, viz., "That the Remembrancer and solicitor be instructed to take the necessary steps to obtain a licence for electric lighting, in accordance with the resolution passed on October 24th last."

The Electric Lighting of the Bazaar of the Bon Marché.—We know that the two largest novelty stores in Paris are the Louvre and Le Bon Marché. For a long time the first has been chiefly lighted by Jablochkoff candles, which made their first appearance there in 1877. The illumination is satisfactory, but it presents nevertheless certain inconveniences, such as, for example, the insufficient divisibility of the lights, which necessitates decreasing their lustre by enclosing them in ground-glass globes, which absorb a large portion of the light, and the hissing noise, due to the alternating currents, renders them sometimes troublesome. For an illumination *de luxe* these are rather important inconveniences. Taking this into consideration, the managers of the Bon Marché wished to do better. The progress made in the last few years in electric lighting made it easy to satisfy this desire, and their attention was, of course, turned to incandescence lighting, which, under favourable conditions for working, presents qualities exactly the opposite to the defects which we have just mentioned. The Edison system was chosen. The installation comprises about 480 lamps of the type A (16 candles), divided in nearly equal portions in the basement, used as workshops and domestic offices, and a portion of the ground-floor, consisting of the *magasins*.

These 480 lamps are supplied by two Edison machines of the type K, turning at 900 revolutions per minute, and calculated to supply 250 lamps each at the normal speed. One machine works in the daytime for the illumination of the basement, and in the evening both are put in action for lighting the *magasins*.

These two machines are actuated by a compound steam-engine, by Messrs. Weyher and Richemond, of sixty horse-power, but which is capable of working up to seventy.

In one part of the *magasins*, where the incandescent lamps have replaced—jet for jet—the gas burners, the illumination is very satisfactory as to quantity, but it still leaves much to be desired as regards quality. The lamps flicker, or to use a fanciful expression, respire, indicating by their variable lustre every phase of irregularity in the engine which actuates the generators. This defect is undoubtedly owing to the bad conditions of the provisional installation, to insufficiency of fly-wheel on the engine, and to too great a distance of the engine from the counter-shafting, which necessitates stretching the bands beyond measure, &c. There is fortunately a remedy for this evil, and in a few days this light will present all the steadiness and beauty which characterises lighting by incandescence; we shall then have no more to do than to offer congratulations to the Edison Company and to the managers of the Bon Marché.

Cable News.—The *Philadelphia Press* says:—The cable steamer, *Duchess of Marlborough*, is now in Colon, and is about to proceed to repair the cable thence to Jamaica, which is broken at a point about thirty miles from the port. The Central and South American Cable Company have determined to cut the T piece out of their line—the shank of which now gives us our connection with the system—and to bring the ends of the northern and southern cables into the City of Panama. This will much diminish the power required in transmitting.

The Admiralty charts of the Bay of Panama, as corrected up to 1865, are entirely incorrect in respect to many of the soundings given in them. Captains who endeavour to bring their vessels up the bay at night may find themselves out of their course, and, being unable by soundings to tell where they are, cannot reach the anchorage without waiting for daylight. It is believed the soundings taken by the officers of the s.s. *Silvertown* will add much valuable information on this subject, and enable some corrections to be made at once, since they not only sounded along the line occupied by the cable, but also straight across the bay from shore to shore, thus embracing an extensive area in which no soundings had ever previously been made.

The New Red Sea Cable.—We read in the *Journal Télégraphique de Berne* that the Berber-Kassala-Sourrakim telegraph line not yet being open to the transmission of messages written in European languages, the new cable laid between Sourrakim and Jiddah cannot yet be used for the general service of the international traffic. The Egyptian Telegraph Administration does all it can to be able to open as soon as possible to all correspondence the line from Berber to Sourrakim, but the present political situation of the country near the Soudan does not allow to foresee the time when this opening will take place.

Underground Telegraph Lines.—The first opening of the underground telegraph lines for public service says *La Lumière Electrique*, has taken place in Paris at the Ministry of Posts and Telegraphs. The telegraph lines opened to traffic are the Paris-Lille, Paris-Nancy, and Paris-Dijon lines. After these three named lines, the Paris-Lyon line will be opened.

Mr. W. T. Henley.—It is with extreme regret we learn, as we go to press, of the death of this well-known electrician. The majority of our readers will be well acquainted with his career in connection with the Telegraph Works Company bearing his name.

Telephonic Communication.—On Monday the Glasgow Watching and Lighting Committee considered the desirability of establishing telephonic communication between the various municipal departments and the Telephone Exchange. They ultimately decided, after hearing reports, to make no change in existing arrangements.

Sale of Patents.—It is said that the directors of the Electric News Telegraph Company (Limited), have arranged the sale of their American patents for a sum which will give a bonus of almost 100 per cent. to their shareholders.

Electroliers for the Electric Light, &c.—In the last number of the Electrical Review we noted our visit to the firm of Messrs. B. Verity and Sons, of King Street, Covent Garden. On that occasion the members of the Board of Works for the Strand district inspected the Edison system of electric lighting. We have since had the opportunity of going over the whole of Messrs. Verity's workshops. It would occupy too much of our space to describe all the operations of this eminent firm of ornamental brass-workers for completing their admirable and innumerable designs. Their display at the last Electrical Exhibition (Crystal Palace) will be remembered by all who visited the Concert Hall, the Entertainment Court, with its floral basket supporting 99 Edison lamps, the show-rooms of the Domestic Electric Light Company, and other places. In connection with this subject we may add that Messrs. Verity do not exhibit at the present Gas and Electrical Exhibition. The Holborn Restaurant, which is being fitted up with Edison incandescence lamps, will soon contain some of the most beautiful and elaborate designs for electroliers ever seen designed and constructed by Messrs. Verity. But far better than any remarks from us would be a personal visit to the show-rooms of the firm. The Edison system of electric lighting is shown from dusk till 7 p.m. in connection

with the firm's electric light fittings, to any one presenting a card with name and address. A chandelier with a patent ball and socket joint is worthy of note, as showing how it may be turned and twisted about without injuring the conducting wires.

BRITISH ELECTRIC LIGHT COMPANY, LIMITED.—The following are some of the works recently executed by this company or in hand: Manchester Royal Exchange. This handsome building was illuminated on the evening of the 1st December for the first time with 10 new automatic Brockie arc lights of 3,000 candle-power each (there will ultimately be 17 lamps) and 400 British incandescent lamps, of 15 candle-power each. The light attracted a great many sightseers and was universally admired. The United Steamship Company's steamer *Kjobenhavn*. This vessel has just been lighted with incandescent lamps, which have been tastefully arranged all over the ship, and fitted upon bronze-gilt brackets representing mermaids. The whole presents a very pretty effect, and the lighting, which has now been in operation for nearly two months, has given great satisfaction. The vessel has one arc light. There will probably be sixty more vessels of the same line to be lighted. The following contracts are not quite completed: Messrs. Walker & Son, Oil Mills, King's Lynn; special engine, Gramme machines, and 80 British incandescent lamps. The Civil Service Supply Association, Bedford Street; arc lights and Gramme machines. British India Steam Navigation Company's steamship *Dacca;* 108 British incandescent lamps, 2 arc lamps, and Gramme machines.

THE CRYSTAL PALACE GAS AND ELECTRIC EXHIBITION.—This exhibition was opened on Wednesday last, but we hear that the gas exhibits are more numerous and in a more forward state than those connected with electricity. We propose to treat on the exhibits from time to time.

NEW COMPANY REGISTERED.

CHARAKITE COMPANY (LIMITED).—Capital £8,000, in £5 shares. Objects: To carry out an agreement of 1st inst. between R. E. Goolden and George Adams for the purchase of an invention for an improved manufacture of insulated (?) compounds applicable also to other purposes. Signatories: J. Montgomery Walker, 9, Old Broad Street, 100 shares; J. M. Hyndman, 10, Devonshire Street, W.; C. S. Dawson, 40, Wigmore Street; R. G. Goolden, 8, Hanover Square; G. Adams, 16, Bishopsgate Street Within; L. Mayes, 188, Palmerston Buildings, E.C.; J. C. M'Laren, Oriental Club; one share each. The signatories are to appoint the first directors. Registered 12th inst. by Matthews and Greetham, 26, Bedford Row.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

NATIONAL TELEPHONE COMPANY (LIMITED). — The second annual return of this company, made up to the 1st of September, was filed on the 9th of September. The nominal capital is £600,000 divided into 15,000 preference shares of £10 each and 90,000 ordinary shares of £5 each. Upon each preference share £6 has been called up and the full amount upon each ordinary share. The calls paid amount to £539,618, leaving £11,502 unpaid. Registered office, 11, Queen Victoria Street.

SWAN'S ELECTRIC LIGHT COMPANY (LIMITED). — The second return of this company, made up to the 16th of May, was filed on 26th May. The nominal capital is £100,000, in £10 shares, the whole of which has been taken up. Upon each ordinary share £5 has been called, the shares allotted to the vendor being considered fully paid. The calls paid amount to £37,500 and considered as paid to £25,000. Registered office, 13, Mosley Street, Newcastle-on-Tyne.

PYRAMID ELECTRIC COMPANY (LIMITED).—The return of this company, made up to 11th ult., was filed on the 5th inst. The nominal capital is £80,000, in £1 shares. 2,530 shares have been taken up and 10/- per share called. The calls paid amount to £1,174 2s. 10d., leaving £290 unpaid. Registered office, Whitecroft, Forest of Dean, Gloucestershire.

NEW PATENTS—1882.

5833. "Incandescent electric lamps." J. WAVISH and J. WARNER. Dated December 6.

5850. "Electro-magnets (insulating)." V. W. BLANCHARD. Dated December 8. (*Complete.*)

5861. "Gaso-electric lamps." P. M. JUSTICE. (Communicated by J. H. Loder.) Dated December 8.

5866. "Electric commutators." J. GORDON. Dated December 8.

5870. "Increasing the efficiency of telephones." W. R. LAKE. (Communicated by A. E. Dolbear.) Dated December 8.

5887. "Voltaic batteries." L. HARTMANN. Dated December 9.

5899. "Apparatus for lighting, heating, and communicating by electricity, applicable in part to other purposes." P. R. ALLEN. Dated December 9.

5910. "Electric lamps." F. H. F. ENGEL. (Communicated by F. Kuppermann.) Dated December 11.

5918. "Dynamo-electric machines." H. H. LAKE. (Communicated by R. H. Mather.) Dated December 12.

5926. "Treating for heating and other purposes organic bodies by an improved electropathic method called the bisolenoïdal electropathic method, for the application of which improved bisolenoïdal instruments are employed." H. HANG and A. WIENAND. Dated December 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1956. "Electric batteries." T. J. HANDFORD. (A communication from abroad by B. Jarriant, of Paris.) Dated April 25. 8d. Single liquid electric batteries working with bichromate of potash and injection of air, and which are known as "Grenet" batteries, are not capable of being employed for lighting purposes unless the currents generated are constant and economical, and means are provided for enabling a number of such batteries to be worked without inconvenience. The object of the invention is to enable—1st. The liquid in the battery to be automatically renewed in a constant and regular manner; 2nd. The liquid solution to be as inexpensive as possible, and the elements of the battery to be capable, after having served to generate an electric current of being regenerated or renovated, as well as the other substances which it contains; 3rd. The zinc plates constituting the negative poles of these batteries to remain well amalgamated until completely consumed or worn out; 4th. The carbon plates constituting the positive poles of these batteries to be provided with inoxidisable armatures, and the air blown against these plates to be sufficient to remove all the traces of oxide of chromium; 5th, lastly. When employed for lighting purposes with one or more lamps the batteries to be capable of being controlled or worked with facility, and be brought into action and thrown out of action automatically by locking and unlocking devices operated by electricity.

1999. "Accumulating and storing electric currents, &c." J. B. ROGERS. Dated April 27. 6d. The object of this invention is improved means of accumulating and storing electric currents, and in economically utilising the energy so stored for lighting purposes. According to this invention, the inventor uses small or comparatively small receivers or secondary batteries, within which the current or currents from dynamo machines or other electric force producers is or are taken up and stored as intensity currents, to be used for all lighting purposes in which intensity is desired. Coupled to these small receivers are one or a series of larger receivers of the same or of a different kind which receive the energy or force from the smaller ones. The current in the large receiver or receivers can be stored in quantity to be used as desired for more evenly dividing the flow to the lamps than can be obtained from one sized secondary battery or batteries alone. By the invention, *i.e.*, through larger receivers being supplied from smaller ones, the light is maintained for a much longer period after the dynamo has ceased to work, than by any known system ! ! ! ! ! !

2020. "Obtaining electric light." J. C. ASTEN. Dated April 28. 2d. This invention consists in making the outer or positive carbon or pole of a hollow form, tubular or otherwise, in the interior of which the negative carbon or pole is inserted. The superficial area of the positive pole is greater than that of the negative pole. A nonconductor consisting either of clays or vitrifiable or other suitable materials is placed between the two carbon poles. Another part of the invention consists in surrounding the negative pole with a nonconductor composed as above-mentioned, and placing adjacent to it two or more positive carbon poles. The negative pole may be made of a hollow form tubular or otherwise, and this hollow space may be either left empty or be filled with a material which may either be a conductor or a nonconductor of the materials as above-mentioned. The two poles may be connected by a material suitable for that purpose as is now usual. (*Provisional only.*)

2030. "Electrical switches or changers." The Honourable R. BROUGHAM. Dated April 28. 6d. Has for its object improvements in electrical switches or circuit changers.

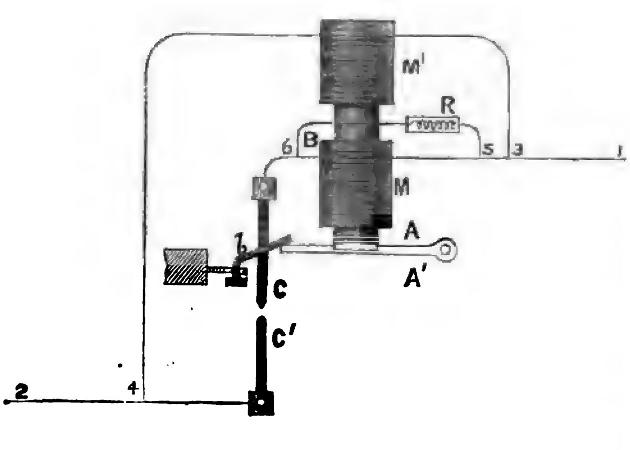
2044. "Dynamo-electrical machines." Honourable R. BROUGHAM. Dated April 29. 6d. Has for its object improvements in dynamo-electrical-machines, and the improvements relate to that class of continuous current dynamo electrical machines in which a cylindrical ring of iron (embraced by a series of coils of an insulated copper conductor ranged in planes parallel with the axis of the ring) is caused to revolve with its circumference in close proximity to the poles of electro-magnets. Usually, as in the well-known Gramme machines, the cylindrical ring of iron has been wound with a series of coils of insulated conducting wire, each made up of numerous turns of insulated wire either circular or flattened, lying side by side and one over the other—and the inner end of each coil and the outer end of the succeeding coil have been coupled by radial strips to insulated metallic bars or plates ranged lengthwise along the axis by which the cylindrical ring is carried. The electric current generated has been carried off from these bars by metallic conductors bearing against the opposite points of the axis. According to this invention in place of constructing the revolving ring of continuous current dynamo machines in this manner the inventor forms each insulated conducting coil by which the ring is embraced of a strip of copper of a width equal to the width of the coil to be formed. The strip before being wound into a coil around the ring is braided or covered over with strands of cotton or other fibre, or is otherwise insulated.

2052. "Electrical generators and engines, &c." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated May 1. 6d. Relates to dynamo or magneto-electric machines, or electric engines, and to apparatus or means for regulating the generative capacity of dynamo or magneto-electric machines. The object of the first part of the invention is to produce a dynamo or magneto-electric machine or electric engine, which will possess the features of exceedingly low resistance, and great strength, compactness, and economy. This is accomplished by the use of a number of discs (preferably of copper) for the bobbin or winding of the armature, which discs are connected to develop (when the machine is used as a generator) a continuous current of electricity having a tension due to the electromotive force of a number of discs.

2065. "Microphonic conductors or contacts, &c." J. H. JOHNSON. (A communication from abroad by Doctor Arsène D'Arsonval, of Paris.) Dated May 2. 2d. Relates to the preparation of substances which possess the necessary properties for forming efficient microphonic conductors or contacts, and to their application for this purpose. A metallic sulphide, such as sulphide of iron, copper, lead or silver, for example, with or without an excess of metal, is melted in a crucible; in certain cases a metallic oxide is added, or a mixture of sulphides of different metals is prepared. These sulphides when melted may be employed either alone or as the cover or coating of a metal which affords them support, either by dipping the metal into the molten sulphide, for example, or by superficially sulphurising the metal itself by exposing it to be acted upon directly by sulphur in a fused or gaseous condition, or by any known chemical process of sulphurisation. (*Provisional only.*)

2068. "Secondary battery." C. H. CATHCART. Dated May 2. 4d. A plate of lead is coated with oxide of lead either chemically or mechanically, and is wrapped in some suitable material, such as flannel, to prevent the oxide from falling off the plate. This constitutes a negative plate. A plate of zinc is coated electrolytically with deposited zinc, and well amalgamated; this constitutes the positive plate. If desired, two of these zinc plates may be used with each negative plate. The above-mentioned positive and negative plates are placed in a vessel containing a strong solution of zinc sulphate acidulated with sulphuric acid, to which other similar salts, such as sulphate of magnesium, may be added if found desirable.

2072. "Electric lights." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated May 2. 6d. Relates to the description of electric lights which are known as arc lights and in particular to the regulating mechanism of the same. One part of the said invention relates to the combination in regulating mechanism of two opposing electro-magnets or solenoids of the same or ap-



proximately the same resistance but of different weights (that is to say having different weights of metal in their coils) located one in the main line and the other in a shunt around the arc and of a shunt circuit formed around the electro-magnet or solenoid in the main line. This part of the said invention is illustrated by the figure. M and M[1] are two electro-magnets (or they may be solenoids) of the same or a[...] the same resistance. The former is located in the line 1, 2, in which are also the carbon electrodes, C C[1], of the lamp, and the latter is located in a shunt circuit, 3, 4, which is formed around the arc or the carbon electrodes. A shunt circuit, 5, 6, with a small resistance, R, is formed around the electro-magnet or solenoid, M, such circuit being joined to the line immediately on opposite sides of the connection of M therewith. The electro-magnet (or solenoid, M, while of the same resistance as M[1], has a greater weight of copper in its coils. When M and M[1] are electro-magnets, as in the example illustrated, they act oppositely upon a stationary core, B. The armature, A, is carried by a lever, A[1], which works a gripping eye, *b*, or other suitable device for lifting the upper or positive carbon electrode, C, to form an arc and for regulating the feed of such carbon electrode. When M and M[1] are solenoids they may act upon the same movable core which can be connected directly with the lever or arm that works the gripping eye. When C and C[1] are in contact M predominates and lifts C, so as to form the arc. When the arc increases to a definite degree, M[1] counteracts the sustaining effect of M and C is allowed to drop until again arrested by M. The low resistance shunt circuit, 5, 6, reduces the resistance of the main line and allows the current to flow freely to the lamps.

2107 "Electric safety apparatus for theatres, warehouses, &c." P. JENSEN. (A communication from abroad by R. J. L. Haviland, of Vienna.) Dated May 4. 6d. This invention consists in an arrangement of apparatus for automatically or at will and by electrical means to cause a stream of water to be thrown into any part of a theatre, warehouse, or other structure in case of a fire breaking out therein, and to cause doors, trapdoors, shutters, and other closing appliances to be opened and the curtain to drop.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations. Dec. 12.	Business Done
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	7½- 8	7¼ m. 7½ ¼ ac.
		Do. Do.	10	15 - 18	15m. 16¼ 16½ ac.
30,000	5	Australasian Electric Light, Power & Storage Co.	3	½- 1	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½- 1	
25,000	5	Great Western Electric Light & Power Co.	2½	½- 1	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	4 - 4½	4¼ ¼ ¼ a.
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	¾- 1¼	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- 1	7/16 m.
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1 - 1½	
..	..	South African Brush Electric Light & Power Co.	2½	¾- 1½	
100,000	5	Swan United Electric Light Co., Limited	2	1½- 2½	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	47½- 48½	47¼ ac.
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	78½- 79½	78¾ 79¼ ac
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	17½- 18½	
130,000	10	Brazilian Submarine, Limited	10	11¾ - 12	
16,000	10	Cuba, Limited	10	9½- 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6½- 7	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
65,000	20	Direct United States Cable, Limited, 1877	20	11¾- 11¾	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10¾-11¼	11 m.
70,000	10	Do. 6 per cent. Preference	10	13½- 13¾	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 -106	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11½- 12¼	11⅝ ac.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	108 -111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	105 -108	
140,000	100	Do. do. registered, repayable 1900	100	105 -108	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 -104	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limite	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6¾	6¾ m. 6⅝ ¾ ac.
163,209	10	Do. 6 per cent. Preference	10	12½- 12¾	
125,000	10	Great Northern	10	12¼-12¾	12⅛ m. 12⅜ ac.
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28½- 29½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	31 - 32	
38,148	10	London Platino-Brazilian, Limited	10	4½- 4¾	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	6 - 8	
9,000	8	Reuter's, Limited	8	12½- 12¾	
280,000	Stk.	Submarine	100	250 -255	
58,225	1	Do. Scrip	1	2½- 2¾	
4,200	Cert.	Submarine Cables Trust	100	104 -106	
37,350	12	Telegraph Construction and Maintenance	12	32 - 33	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7½- 7¾	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	96 - 99	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building)Bds.	$1,000	122 -1[illegible]	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -[illegible]	
88,321	10	West India and Panama, Limited	10	[illegible]	
34,563	10	Do. 6 per cent. 1st Preference	10	[illegible]	
4,669	10	Do. 6 do. 2nd do.	10	[illegible]	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos 1[illegible]	[illegible]	[illegible]	
200,000	1	Oriental Telephone Co., Nos. 100,00[illegible]	[illegible]	[illegible]	
100,000	5	United Telephone Co.	[illegible]	[illegible]	

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 265.

THE INSTITUTE OF PATENT AGENTS.

IN our other columns will be found the inaugural address of Mr. J. H. Johnson, the President of the above Institute, and there will also be observed the objects for which this new association has been formed. In the presence of the pending and very necessary legislation for the revision of the Patent Laws, we look upon this co-operation of patent agents as a decided step in the right direction. As Mr. Imray, the Vice-President, very truly remarked in the course of his speech, there are a thousand little things in the practice of the Patent Laws which an institute, speaking with authority as a responsible body, can compass, when no individual patent agent can do anything. This gentleman also thinks that the great difficulty which arises from the way in which the certificates of allowance for patents are issued from the offices of the Solicitor-General and Attorney-General might be rectified by such an institute, and he moreover stated that the Council was busily engaged with this very object.

But leaving such matters for consideration at a future time, we cannot but think that as far as the inventing, manufacturing, and speculating public is concerned the formation of the Patents Agents' Institute has been carried out at a most opportune moment. Probably at no period have inventions been so numerous as at the present day, and certainly we have never before had such pressing need of scientifically and legally skilled agents to correctly carry out the ideas of inventors. Many a promising idea has been spoiled by the clumsiness, indifference, or ignorance of the agent to whom the inventor had intrusted the outcome of his brain.

There are many who prefer to act as their own agents, when they have originated some scheme worthy of protection by letters patent. This we do not believe to be either an economical or wise transaction, leaving alone the amount of worry and extra work entailed. When a man has devised something he desires to patent, it is better and cheaper for him, in the end, to have his invention set forth in strict and proper terms by some reputable agent who knows exactly how much to express and what to leave out. Therefore, speaking in our particular province only, we say that the Institute of Patent Agents will be found a most useful association, and its promoters will deserve well of inventors.

We shall know that its members are men of knowledge, scientifically and legally, and that they are certificated as being competent to discharge the duties intrusted to them.

A great advantage attached to an amalgamation of professional men of any description is the opportunity afforded of clearing up any doubtful points connected with patent claims by discussions amongst themselves.

We could point out one well-known patent containing one claim only (it originally had 30) on which probably more difference of opinion exists than on any other which has gone before.

Up to the present time the patent agents have had no such advantage as this we have mentioned appertaining to other professions, but now all obscure points can be thoroughly ventilated and correct decisions arrived at.

We trust that the Council will be always on the alert to keep from the body of the Institute those whose claims to the title of patent agent are considered at all doubtful, and then the respectable members of the profession and the public too will reap a mutual benefit.

W. T. HENLEY.

WE have lost in the person of Mr. Henley, whose untimely and sudden death we recorded last week, one of the earliest pioneers, and probably the most energetic worker in electrical science. His career was a most remarkable one, and gives us another example of what dogged perseverance and an undaunted spirit may achieve in the face of difficulties which would dishearten and crush the majority of men. He was fond of relating his experiences, in a modest and diffident manner, to those in any way connected with him, and his biography would form one of the most interesting subjects we can conceive in relation to matters electrical.

The space at our command will not allow us to produce more than a brief outline of his chequered experience, a subject on which we have conversed with him many a time and oft.

Mr. Henley was born at Midhurst, in the County of Sussex. After receiving a fair education, he was brought up by his grandfather and his uncle, who were leather-dressers, to that trade, but not liking the business, at 16 he left the country to seek his fortunes in London. He began as a light porter at a silk mercer's in Cheapside, and afterwards worked in the docks as a labourer for some five years. Meanwhile he taught himself the use of tools, and fitted up in the single room which he occupied, a bench made with his own hands, vices, throws, &c.; and morning and evening, before and after the work of the day, he successfully manufactured philosophical and electrical instruments, which were placed in a shop close at hand (a chemist, we believe), for sale. He thus attracted the attention of scientific men, and morning and evening, before work, and after work tired with the heat and burden of the day, young Henley pushed on in the endeavour to reach the goal of his ambition.

At twenty-four years of age, being a dexterous workman in electrical apparatus, he was employed by Professor Wheatstone when developing his telegraph, assisting in Wheatstone's experiments and gaining an extended acquaintance with electrical science.

When the first Electric Telegraph Company was formed Mr. Henley did a large amount of work for them in instruments, but having partially executed a large order for the company, which they for some reason cancelled, he went to law with them, and they resolved to give him no more work. He then invented his magnetic telegraph and formed a powerful company, who purchased the patent for £68,000 in cash and shares.

It is related how, when hindered by the old Electric Telegraph Company, who had possession of all the railways, and had obtained a monopoly for overhead work, from erecting

competitive wires, Mr. Henley retorted by digging trenches and laying underground wires from London to Carlisle, and from Dublin to Belfast. When the Government took over the telegraph lines of the country, Mr. Henley's Company was, of course, included.

He afterwards built the telegraph works, 12 acres in extent, at North Woolwich, and made submarine cables one after another, employing for this purpose upwards of 2,000 men. He manufactured about 14,000 miles of submarine telegraph cables, the greater portion of which he also laid. Finding that purchasing his wire placed him at a disadvantage in competition, he laid down the machinery and plant for drawing his own wire at the North Woolwich Works. After a time this led to a works in Wales for making the wire rods, and later on sheet iron. Still later Mr. Henley essayed the galvanising and corrugating of iron at North Woolwich.

For some years he was extraordinarily successful, and then from reasons not necessary to mention here the North Woolwich works were reduced to a very small part of their original extent, and operations have since been carried on by a company formed for the purpose of taking over the business.

Latterly Mr. Henley's name has been before the public in connection with his patent ozokerited india-rubber core, of which we have tested some hundreds of miles, and have on various occasions spoken favourably of its valuable properties. He was also engaged in perfecting a system of dynamo-electric machines and lamps for electric lighting when so suddenly taken from his earthly labours.

Mr. Henley's rough, but genial presence, will be keenly missed by the poorer inhabitants of North Woolwich, for his charitable deeds, although hidden from the world at large, were continuous to the deserving, and it is also to be feared to the undeserving, who could so readily impose upon his simple and generous nature.

Mr. Henley, who died at the age of 68 from congestion of the lungs, brought on by a chill caught only a week before, was interred in Kensal Green Cemetery on Monday last, in the presence of numerous and sympathetic friends.

ELECTRICAL EXHIBITIONS.

By W. H. PREECE, F.R.S.

(Paper read before the Society of Arts, on Wednesday, the 13th inst.)

Exhibitions and displays of the practical applications of science to the useful wants of man have been cropping up during recent years with marvellous rapidity and fecundity. They owe their origin chiefly to the great Loan Collection of Scientific Apparatus, which was held at South Kensington during the latter six months of 1876. This was the first real electrical exhibition. In the Great Exhibition of 1851, one of the thirty classes into which the exhibition was divided, was devoted to "Philosophical instruments, and processes depending upon their use," and a small subdivision of this class was devoted to Magnetism and Electricity. Here we had mariners' compasses, electric telegraphs—then in their infancy, the application of electro-magnetism as a motive-power—still in its babyhood, the electric light—well matured even then, electric clocks, therapeutic applications, and electrotype apparatus. Here was shown the first submarine cable, Dr. Joule exhibited his great electro-magnet, and Hjorth the Dane—the fore-shadower of the electro-dynamic system—showed his early ... obtain motive-power by electro-magnetism, but the show was small, and only really interesting in the telegraphic branch; and I think it was here that the Chairman of our Council received his first public award in England, for the very fine exhibit his firm (Siemens and Halske) made, and which richly earned a Council medal. In 1851, electricity played but a very minor part. In the next Exhibition of 1862, great progress had been made, and though the same classification was adopted as in 1851, the electrical subdivision was very much larger. An extremely able report on the electrical instruments displayed was written by Professor Fleeming Jenkin. Improvement and progress were still confined to telegraphy; but, in the meantime, submarine cables had become practical and commercial undertakings. The Atlantic had been spanned, and a very strong stimulus had been given to scientific research, from a practical point of view. Sir William Thomson had brought his brilliant intellect to bear on this virgin soil, and the result had been that the Exhibition of 1862 denoted very great progress in invention and constructive skill, and displayed a numerous and excellent assortment of electrical appliances for other purposes than telegraphy. For instance, the electric light was one of the attractions of the place. Duboscq and Serrin, of Paris, Jaspar, of Liege, and Holmes, showed their arc lamps in operation. The magneto-electric machine and lamp of the last exhibitor had been working at the Dungeness Lighthouse from the previous year to the year 1875. Holmes' machine still works the South Foreland and Soutar Point lighthouses under the care and management of our excellent Trinity House. I remember very well an electric engraving machine and an electric loom at the 1862 Exhibition.

In 1871 we had another International Exhibition, chiefly associated in our memories with the loss of the founder of the great Exhibition of 1851, and our own much revered President. It was not a success, and I can find no record of the exhibition of any striking electrical novelty. It was not comparable with the Exhibitions of 1851 and 1862, and it was not followed by any such valuable report as that of Professor Fleeming Jenkin on the Exhibition of 1862.

There were great and successful International Exhibitions held in Paris in 1867 and 1878. The latter was epoch marking, for though electricity formed but a very small subsection, it was the occasion when Jablochkoff lighted up the Avenue de l'Opéra, and produced such a consternation among gas shareholders. The Pavilion, illuminated by him, was one of the striking features of the show. Here, also, we saw the great developments made in the electro-dynamic machine by Gramme and Siemens.

At Vienna, in 1873, a very successful exhibition took place noteworthy for being the occasion when Fontaine first showed the capital experiment of transmitting power by electricity. A gas-engine moved a dynamo-machine (the generator), which turned another dynamo-machine (the motor), 1,000 metres off, that worked a centrifugal pump.

Philadelphia, the Great Centennial Exhibition of 1876, is celebrated for Bell's great experiment of transmitting or rather reproducing speech by electricity. It was here that Sir William Thomson heard Shakespeare quoted through an ordinary telegraph wire by means of "the greatest by far of all the marvels of the electric telegraph."

There was an Industrial Exhibition in Berlin in 1879, which is interesting from the fact that here Siemens worked the first tramway by means of electricity, carrying eighteen persons.

The first electrical exhibition was that of 1876. In the previous exhibitions electricity played a small subsidiary part—here it came into prominence and took the leading place. It was intended to display scientific apparatus employed for teaching and for investigation, and also such as possessed historic interest on account of the persons by whom or the researches in which they had been employed. It became also a very fine exhibition of the practical applications of electricity. It was international in its character, though not in its design. A very large number of exhibits were sent from abroad. It was supported by the most eminent physicists and scientific men on the continent. Abroad, it obtained a reputation it never reached at home. It was most unfortunate in its title. "The Special Loan Collection of Scientific Apparatus" was not attractive. The press, far

some unaccountable reason, decried it. The general public shunned it, and though 213,196 people visited it, it never acquired the popularity then, which it certainly would acquire now, if it were held again, and given a more telling title. But such priceless treasures as were brought together there will never be brought together again. The catalogue and publications issued by it form a small library. There was not only an admirable catalogue—one of the best ever compiled—but a handbook of short descriptive essays, written by such men as Clerk Maxwell, Clifford, Spottiswoode, Tait, Carey Foster, Norman Lockyer, Geikie, Huxley, and others equally eminent.

There were 1,404 exhibitors, of whom 761, more than half, were foreigners, derived from the following sources:—

United Kingdom	643
Austro-Hungary	46
Belgium	18
France	116
Germany	378
Holland	33
Italy	47
Norway	9
Russia	70
Spain	14
Switzerland	30
	1,404

The number of objects exhibited was about 13,000. There was held, in its earlier days, also a conference of scientific men, at which 110 papers were read, and which brought together an average attendance of seventy persons. There were no less than fifty-three evening lectures, to which admission was free, and at which the average attendance was 425. At these conferences and lectures explanations and demonstrations were made of the method of using and employing the various instruments exhibited. The historical portion of the exhibition was the richest of its class that has ever been held. Notwithstanding all this, the exhibition fell dead, and it is now but little remembered. It came before its time.

The Electrical Exhibition of Paris, of 1881, was more fortunate. Owing to the excitement consequent on the activity of electric light promoters, and of the startling invention of the telephone, the public had become interested in electricity. The title, "electrical exhibition," was attractive, and the energy and enterprise of M. Cochéry, the Minister of Posts and Telegraphs, brought together very strong support from other nations. Hence the Paris exhibition became, in every sense of the word, an "international electrical exhibition." Here we saw every nation vying with each other to see how the electric current could, economically, supplant gas as a domestic illuminant. Here we saw, for the first time, Edison's solution of the problem, and the progress made by his great English rival, Swan. Here we saw Duboscq, Serrin, Jaspar, and Siemens, with their experiences since 1851, indicating the progress they had made during the past thirty years. Again, we saw telegraphs moulded by experience, invention, and practice into fine race-horses, compared to the heavy dray-horses of the former period. In 1851, it was scarcely possible to send twenty words a minute; here we saw 200 words a minute transmitted as a matter of course. Only one message could be sent on one wire in 1851; in 1882, two, four, six, and eight messages were shown in transit simultaneously, on one wire. The telephone had sprung into existence. Music was transmitted from the opera, and the words spoken on the stage were distinctly heard a mile or more away. Boats were propelled by electricity upon a small lake, and ploughs were moved, printing machines worked, balloons gyrated about in the air, sewing machines rotated by currents of electricity produced a long way off. Here again, we saw how electricity can be employed to give instant warning of fire, and by-the-bye, how few there are who avail themselves of this useful and valuable application. Not only can we, by merely touching a button, raise an alarm of fire in the police-station or in the fire-engine station, but we can make the fire itself, in its early stages, automatically raise an alarm, and practically say, "Here I am burning away nicely and merrily in the library, will nobody come and put me out?" In the face of the terrible fire that London witnessed last week, it is hoped that some attention will be given to this most beautiful application of electricity, which was so fully shown in Paris and subsequent exhibitions.

The Paris Exhibition produced no striking novelty. It illustrated, rather, progress. New methods, new combinations, new applications were numerous, but absolute novelties were absent. It however showed the practical man to be ahead of the philosopher, and illustrated the fact that in the case of electricity the science owes more to practice than to theory. Unlike the exhibition of 1876, the press, especially the *Times*, met the want of the public, by publishing very full and able reports of the work done and descriptions of the things shown. The exhibition was also the occasion of the meeting of a very important congress of electricians of all countries, at which numerous questions were discussed, but at which the most important was the establishment of a uniform system of electrical measurements. In this field of measurement there was no deep-seated *inch* to brush aside, nor time-honoured *shilling* to drive into oblivion, but the coast was comparatively clear. The quantities to be measured were little known, few had been working on the question, and therefore the difficulties to surmount were not many. The necessity, however, for a uniform system of standards, and a universal system of nomenclature was paramount, and hence a coherent system was proposed, accepted, and universally adopted with wonderful celerity. This speedy adoption was the most striking proof of its necessity. Men wanted to know how much electricity they were using to produce given effects, how much electricity was the result of certain mechanical operations, how much electricity could be conveyed to a given distance by a given wire. Moreover, as electricity was the result of mechanical motion, it was clear that there must be an intimate connection between motion and electricity. And as all motion involves *time* and *space*, and mechanical motion *matter* also, so electrical measurements must be based on mechanical ones. Hence the centimetre as the unit of space, the gramme as the unit of mass, and the second as the unit of time, have been taken as standards, and the system is therefore called the C.G.S. system of units. Now we have in electricity, *electromotive force*, that determines its flow; *resistance*, that opposes this flow; and *current*, the flow itself. But electricity can also be stored up in a kind of caged condition, ready to burst out into lightning, or to flow out gently, "to waft a sigh from Indus to the Pole." It is then held prisoner by induction, the magnitude of which is measured and expressed by the term *capacity*. Now, a unit of electricity is called a *coulomb*, and if this unit, under the influence of a unit electromotive force, flows for one second through unit resistance, it produces a current of one *ampère*. The standard resistance is called an *ohm*, while the standard electromotive force producing the flow is called a *volt*. If this coulomb so produced were stored by induction, then the capacity of the configuration maintaining it would be called a *farad*. The capacity of a conductor is thus measured by the quantity of electricity it will hold, as a cask is measured by the quantity of wine it holds.

The ohm can be represented by a column of mercury 1·0615 metres long of a square millimetre section at 0° Centigrade.

The volt is very nearly the electromotive force of a Daniell cell.

An ampère is very nearly the current required to maintain an 18-candle glow * lamp alight.

A farad is too large for practical purposes. So we take a millionth part of it, and call it a *microfarad*, which is the capacity of about three miles of an Atlantic cable.

Some idea of the quantity of electricity involved in electric lighting may be gathered from the fact that it would require 3,000,000 miles of the Atlantic cable—an area of seventeen and a-half square miles—to hold the quantity of electricity that passes through each lamp in this room in each second of time. It is comparable to the charge contained in a thunder-cloud before it bursts out in lightning. For a cloud offering three square miles area at a moderate height—say, 100 feet—the charge would not be more than one coulomb.

* I accept this term "glow," proposed by Dr. Siemens. Glow lamps are sometimes called "incandescent," sometimes "incandescence"; the latter is the more correct, but the less euphonious. Glow is equally correct, far more euphonious, and more in accordance with the spirit of the age.

Now, when electricity flows through resistance, it does work upon the matter through which it flows. Hence heat is produced, and hence glow. Now, this work done depends upon the current flowing and on the electromotive force present. If we multiply the electromotive force by the current, we have a measure of the energy expended. Hence one volt × one ampère = one watt, which is the unit of electrical work. Seven hundred and forty-six watts equal 1 horse-power; so that we have a very ready means of converting the expression for electrical energy into that of mechanical power, and *vice versa*. Each glow lamp in this room is worked by 105 volts, and ·8 ampère, or it requires an absorption of 84·0 watts, something less than one-tenth of a horse-power per lamp. Now all these units, except the watt, were chosen by the Electrical Congress at Paris, in 1881, and they have been accepted by all the world. This is the great result of the Paris Exhibition, and that which will mark it as an epoch in the history of electricity.

The success of the Paris Exhibition led to an imitation of it at the Crystal Palace in the early part of the year. As a practical and popular exhibition, the result was undoubtedly a success; but it was mainly a commercial undertaking, and could not in any real sense be called international. It followed the Paris Exhibition too quickly. There was a very fair display of electrical appliances; over 300 exhibitors sent things there; but it was chiefly as an electric light exhibition that it will be remembered. Telegraph instruments and bells, telephones, and cable grapplers were mixed up too much with toys, weighing machines, and toilet commodities to give it a scientific character. As a practical demonstration of electric lighting it left nothing to be desired, but as an event marking scientific progress it must soon be forgotten. A new exhibition, in which gas plays a prominent feature, opens there to-day, with what prospect of success I cannot say.

(*To be continued.*)

ON THE APPLICATION OF ELECTROMOTIVE POWER TO MARITIME PURPOSES.

By A. RECKENZAUN, C.E.

(*Continued from page* 472.)

THIS force will propel a screw launch having a displacement of about three tons, at the rate of nine miles per hour. The cost of each cell depends upon the material, mode of manufacture, and the maker's profit combined. I shall, however, be asked, How much does it cost to charge the cells; or, what is the expense of filling them and re-filling them with electrical properties? This I must reply will depend upon a number of circumstances—for instance, upon the place and the method adopted for the purpose of generating the electric force requisite therefor: if we have water-power or wind at our disposal, it will cost next to nothing; while, if we must depend upon steam-power, we must take the cost of the fuel at the particular locality into account. This cost of fuel also depends in great measure upon the economy and construction of the boiler, furnace and engine utilised. A good condensing engine will not consume one-half the amount of coal which a small, but good launch-engine would, and since the efficiency of our whole electrical apparatus will be more than 50 per cent., we may safely assert that the electromotive power will not be *more* expensive than steam-power for our boat.

Hence the application of electricity to the propulsion of *small* vessels is not only possible, since we have just demonstrated that fact; but it is also commercially advantageous.

In order, however, that electric-launches may come into general use, it will be necessary to establish stations at which the batteries may be charged and re-charged; on the banks of our larger rivers there will be little difficulty in finding the required force, and a small dynamo is all that is needed for the purpose: we may even make use of the motor itself to produce the charging current, if we find a motive-power, from whatever source this power may be procured.

Turning now from the peaceful launch we may proceed to direct our attention for a moment to the warlike torpedo-boat.

Numerous are the peculiar qualities demanded in a boat of this description, and this species of craft requires the most delicate management, as well as the utmost skill and ingenuity on the part of him who designs, builds, or equips it for service. No expense is spared to secure the fulfilment of all the requirements necessary to a perfect torpedo-boat, and this class of vessel has of late played quite as important a part in naval engineering as any other—not excepting the ironclad. To make this boat invisible to the enemy has been the study of some engineers, to impart to it the highest possible speed the ambition of others; while to make it noiseless, to prevent the emission of smoke or vapour-clouds from its machinery are most essential points with all who wish to render it perfect. All of these can be secured by the employment of electric-power for their propulsion, and I venture to think that in course of time it will entirely displace steam on board of torpedo-boats. The noise of an electro-motor is no greater than that of a well-oiled, well-fitted revolving cotton-spindle, and can scarcely be heard at the farther end of the vessel; having neither smoke nor steam another of the greater difficulties is obviated. Speed has a limit in the steamboat just as in the electric-boat. Electrical machinery is far more easy of management than steam machinery, for one man can just as quickly and with as much ease turn on or off and regulate the current of several hundred accumulators as he could press the button of an electric bell, while very little skill or practice are required in handling the different portions of the apparatus.

Now to prepare a *steam* torpedo-boat for service is a serious affair; steam must be got up hours before it can start; three sets of stokers and three engineers must be constantly in attendance to attend upon and watch the fickle-minded concern: while, on an electric-vessel, the accumulators can always be in readiness; one turn of the switch-handle suffices to start it; and it will then require no further care or attention, except to steer it, until it arrives at its destination, which, in most cases, will be in a short space of time. The electro-motors, batteries, and accessories will, of a necessity, come below the water-line—for it would be difficult to place them above—protection is thus obtained from the shot of an enemy, so far as the propelling machinery is concerned, and in a greater degree, by reason of its smaller size, than for that of the steamer. But, besides propelling the boat, the accumulators are as capable of other duties as the steam-engine, such as steering her, lifting the anchor, &c., while, in addition, they can do what the steam-engine alone cannot, viz., throw an intense light upon any particular place or object, and fire the gun if there be one on board.

These are in brief and roughly noted the most elementary yet important points; more minute details I must leave to the specialist.

One more use to which this motive-power might successfully be applied in time, in connection with naval affairs, is, I think, in the steam-launches carried on board many of the larger men-of-war for the landing of armed parties and the heavier guns for shore duties; and for other purposes when, in case of danger or other sudden emergency, a small or light-draught and swift vessel is required at short notice. How much handier and readier would not an electric-launch be, with its power ever at the command of the moment, without notice, without hurry or anxiety?

The next small craft of importance is the ferry-boat; one without oars, without sails, without a towing-chain and without a boiler—a floating bridge on which the passengers need not be suffocated by smoke nor drenched with the greasy, condensed exhaust-steam, nor besmeared by the black, dusty remnants of imperfect combustion. Powerful ferries must be provided where the traffic demands them: but in very many instances the traffic is great only at certain hours of the day—perhaps four or six runs bring the bulk of the day's passengers and goods—yet when, as hitherto, there is no alternative to steam, the fires must be kept up in the boilers and the attendants retained on duty between times, and during the far greater number of hours in which the ferry is but seldom required. Such a ferry-boat, if propelled by electricity, is constantly ready, so long as there remains a charge in the accumulators—and the loss of

charge while at rest amounts to less than one per cent. during a whole day's work—yet no attendance is needed, until the moment arrives to start; and then the one man who starts and stops the machinery can also with facility steer as well: so that, were it not for the mooring at the piers, no other person would be required to assist. Just as the captain of the Woolwich ferry at this moment may be touching the button to ring the signal bell for starting, stopping, or reversing the engine, so he might with no greater exertion himself, direct the whole machinery, if worked by electricity in place of steam, from the bridge, by simply touching the handles or buttons of the switches which convey the current. By two small instruments near these handles he could at any time inform himself of the state of his motive-power, and see at a glance what current there is, and what electromotive force. He would need no longer to tremble at the possibilities of mistakes on the part of his engine-driver or fireman; and the safety of his passengers would be proportionately increased as the number of "hands" in charge was decreased; for the captain can sooner reverse his apparatus himself than he can correct a wrongly-understood command in the moment of danger.

I may mention that in some instances of ferry propulsion it would be an easy matter to dispense entirely with batteries on board, if found more convenient, as we could convey the current from shore to the machine on board by either a submarine cable or an overhead wire, thus connecting the generator and the receiver by any convenient means. Instead then of carrying the weight of the cells we could use merchandise as ballast and save freightroom at same time.

The electric tug-boat will in many ways prove superior to the steam-tugs, since it is more easily managed, not so liable to get out of order, and, during the long intervals of waiting outside the bar of the harbour for the ship to tow into port, the maintenance will be cheaper.

As for the passenger traffic in the tropics, those who have experience of steamers on Indian waters may best be able to give an opinion. The steam boiler and machinery in such circumstances have often been described as intolerable accompaniments of travel in those countries. Not to dwell upon the discomfort to travellers of the close proximity of the engine-room; firemen fainting and dropping dead in the stokehole through the effect of the excessive heat is a daily occurrence. Every possible precaution is taken to relieve these poor sufferers as far as can be—ventilators are placed in every part of the ship; but the air, already hot, affords but little appreciable relief; the exhausted, half-nude fireman rushes up the ladder every few minutes for a breath of the outer air, and runs down again to attend to the furnaces and safety valves of his boilers, suffering the utmost agony; and the most robust men are soon rendered prostrate with hardly a remedy. The swift revolving armature of our electro-motor, on the other hand, agitates the air in its vicinity, and the sensation when standing near it resembles that caused by the gentle wafting of the zephyr by a lady's fan.

Having thus far given a very rough and general outline of the advantages afforded by the employment of electricity in the continuous propulsion of small vessels, I venture to proceed to indicate in brief a few other possible adaptations of this subtle force to the purposes under review. Commencing again with pleasure-boats, which play no small part in the industries of maritime nations, I may be permitted to suggest the application of electric energy to the auxiliary propulsion of sailing-yachts. Yachting is probably one of the most interesting sports to an Englishman; but how often is he caught in a dead calm and exposed to the dangers and involuntarily at the mercy of the silent mirror on lake or bay, or surprised by sudden squalls, when every sheet must be stowed, and he is compelled to "lie to" under bare poles, completely at the mercy of the waves, till the fury of the storm has passed, scarcely able, from the lightness of his craft, to keep her "head to wind"? He may well desire to move, if only at the rate of a few yards an hour. How often is he caught on a lee-shore in either calm or tempest—the tide setting landwards, and his only hope of safety the "making a good offing"? An auxiliary steam-engine and a prosaic boiler with its unsociable attendant would at once destroy the poetry, the beauty, cleanliness, and comfort of a fairy yacht, the very suggestion would almost be deemed a mockery and an offence by an enthusiastic yachtsman. A funnel to a sprightly, smart, and trim sailing-yacht would in his eyes seem worse than a sailor in spurs. On the other hand, a small dynamo and a set of secondary cells under the cabin-floor would at once serve the purpose of the usual stone or iron ballast, be out of the way, invisible, harmless, and still in an emergency be handy, ready for use, certain to act on the moment, and of vital importance to life and property. To propel a yacht by a small screw a few miles per hour would involve a small expenditure of force; but a force available or not at will, without preparation and requiring in use no skilled "hand," and not even wounding the *amour-propre* of a sportsman nor blemishing the good name of his craft.

For sailing-ships making long voyages I could not, in the present almost experimental state of this subject, recommend auxiliary electric propulsion—the dead calm may last longer than the stored force; nevertheless, there are several ways in which electric-power may be usefully and economically applied on board even a large sailing vessel—ways in which steam on such ships cannot offer the same advantages at a similarly low cost. The steering of a large vessel when under full sail, going any usual speed, is a matter of hard work, often too hard for muscular power available when a heavy gale is blowing: on such occasions steamers can resort to their steam-steering gear, which a child could manage; but the sailing-vessel must do as best she can with manual labour, which often can be but ill-spared, in sufficient strength, from other important duties in a storm. Mechanical power would be of great advantage and the only such power which, without elaborate and lengthy preparation, we can bring to bear, which we can conveniently store, and that will give us a great force for a short time is electricity. The batteries could be shipped fully charged and the used-up energy replenished at odd hours by manual labour when the "hands" are comparatively idle—often during a calm or a long spell of fair wind, in real want of exercise. A windmill would effect our purpose and could be hoisted at convenient times to drive a dynamo on board. This electric energy once introduced on a ship would be available for many things—weighing anchor, furling sails, driving the winches in small ports where steam cranes do not exist; for pumping, should she spring a leak; and also—perhaps mainly—for lighting purposes. The advantage of lighting ships by electricity has already been admitted and the method adopted on several of the principal steamship-lines; but accumulators are only now being resorted to, experience having proved that these batteries are indispensable to the *successful* carrying out on any large scale of electric lighting.

Whatever may happen to the steam-machinery, whether it be temporarily disabled or at rest in harbour, the secondary batteries on a steamer so equipped continue to supply the light for many hours with certainty and economy. In hot countries the ventilating fans would be driven by this same apparatus in harbour and at sea.

Other uses to which this friendly, harmless force might be applied will readily suggest themselves to you; but, having enumerated the most important, I will not dwell upon further details.

In conclusion, I would observe that, although electricity may be for many purposes economically employed, there seems to me to be little hope as yet that it will quite supplant steam in those operations requiring the highest degree and development of power—such as, among others, ocean navigation.

ELECTRIC BELLS AND SIGNALS AT HER MAJESTY'S MILITARY PRISON, LANCASTER CASTLE.—Since this castle was converted into a military prison great inconvenience has been experienced by the mechanical signals from each cell being unworkable, also from the chief warders having no means of signalling to each other in case of need. Mr. Sharples, electrician, of Preston, was instructed to arrange a system of electric signals. This has been done and the work completed; a somewhat difficult task, as the walls were in many places 3 yards thick. Over 90 of the cells have each an electric bell push, so made and arranged that the prisoners cannot damage them. All communicate with an indicator in the chief warder's office, and the different warders' offices are connected with each other by electric bells.

APPROXIMATIVE PHOTOMETRIC MEASUREMENTS OF SUN, MOON, CLOUDY SKY, ELECTRIC, AND OTHER ARTIFICIAL LIGHTS.

By Sir WILLIAM THOMSON, F.R.S.

THE author pointed out that the light and heat radiated from hot bodies were but the different modes in which the energy of vibration induced by the heat was conveyed to our consciousness. A hot kettle, red-hot iron, incandescent iron, platinum, or carbon, the incandescence in the electric arc, all radiate energy in the same way, manner, and according as it is perceived through the sense of sight, by its organ the eye, or by the sense of heat*, we speak of it as light or heat. When the period of vibration is longer than one four hundred million millionth of a second the radiation can only be perceived by the sense of heat; when the period of vibration is shorter than one four hundred million millionth of a second, and longer than one eight hundred million millionth of a second the vibration is perceived as light by the eye.

Pouillet, from a series of experiments, has deduced a value of the energy radiated by the sun as equal in British units to about 86 foot-pounds per second per square foot at the earth's surface, or about 1 horse-power to every 6½ square feet of the earth's surface. We estimate from this the value of the solar radiation at the surface of the sun. The sun is merely an incandescent molten mass losing heat by radiation and surrounded by an atmosphere of incandescent vapour, so that the radiant energy really comes out from any square foot or square mile of the sun's surface as from a pit of luminous fluid, which we cannot distinguish as either gaseous or liquid. Take, however, instead of the sun an ideal radiating surface of a solid globe of 440,000 miles radius. The distance of the earth being 93,000,000 miles, the radius of the sun is equal to, say, in round numbers, 1-200th of the earth's distance; hence the area at the earth's distance, corresponding to 1 square foot of the sun's surface, is equal to 40,000 square feet. The radiation on this surface is ($40,000 \times 86$ or) 3,440,000 foot-pounds, which is therefore the amount of radiation from each square foot of the sun's surface. This amounts to about 7,000 horse-power, which, according to our brain-wasting British measure, we must divide by 144 if we wish to know the radiation per square inch of the sun's surface, which we thus find to be 50 horse-power.

The normal current through a Swan lamp giving a twenty-candle light is equal to 1·4 ampères with a potential of 40 to 45 volts. Hence the activity of the electric working in the filament is 61·6 ampère-volts or Watts (according to Dr. Siemens' happy designation of the name of Watt, to represent the unit of activity constituted by the ampère-volt). To reduce to horse-power we must divide by 746; and we then find about one-twelfth of a horse-power for the electric activity in a Swan lamp. The filament is 3½ inches long and ·01 of an inch in diameter of circular section; the area of the surface is thus 1-9th of a square inch, and therefore the activity is at the rate of ¾ of a horse-power per square inch. Hence the activity of the sun's radiation is about 67 times greater than that of a Swan lamp per equal area.

In this country the standard light to which photometric measurements are referred is that obtained from what is known as a standard candle. Latterly, however, objections have been raised against its accuracy. It has been said that differences of as much as 14 per cent. have been found in the intensity of the light given by different standard candles, and that serious differences have been observed in the intensity of the light from different parts of the same candle in the course of its burning. The Carcel lamp, the standard in use in France, has been regarded as the only reliable standard. It is, no doubt, very reliable and accurate in its indications, but it should be remembered that its accuracy is greatly owing to the careful method and the laborious precautions taken to secure that accuracy. If something akin to the precautions applied to the Carcel lamp by Regnault and Dumas were applied to the production and use of the standard candle, there is little doubt but that sufficient accuracy for most practical purposes could also be obtained with it; probably as good results as are already obtained by the use of the Carcel lamp.

At the Conference on Electrical Units which met in Paris lately, a suggestion was made to use as a standard for photometric measurements the incandescence of melting platinum, and very interesting results and methods in connection with the proposal were presented to the meeting.

For approximative photometric measurements the most convenient method is certainly that of Rumford, by a comparison of the shadows cast by the sources of light on a white surface. The apparatus necessary are only a piece of white paper, a small cylindrical body such as a pencil, and a means of measuring distances. Ordinary healthy eyes are usually quite consistent in estimating the depth of shadows, even when the shadows examined are of different colours, and with a reasonable amount of care photometric measurements by this method may be obtained within 2 or 3 per cent. of accuracy. The difference in the colours of the shadows is of course due to each shadow being illuminated by the other light.

Arago has compared the luminous intensity of the sun with that of a candle and estimates it as equal to about 15,000 times that of a candle flame.

Seidel, as the author has been informed by Helmholtz, estimated the luminous intensity of the moon as about equal to that of grayish basalt or sandstone. An experiment on sunlight, made in Glasgow on the 8th of this month (since this paper was read), compared with an observation on moonlight, which the author made at York during the meeting of the British Association there, in 1881, has led him to conclude that the surface of the moon radiates something not enormously different from one-third of the light incident upon it. The observation on moonlight referred to above showed the moonlight at the time and place of the observation (at York early in September, 1881, about midnight, near the time of full moon) to be equal to that of a candle at a distance of 230 centimetres.

The luminous intensity of a cloudy sky was found about 10 a.m. one day in York, during the meeting of the British Association, to be such that light from it through an aperture of one square inch area is equal to about one candle. The colour of its shadow, compared with that from a candle, was as deep buff yellow to azure blue: the former shadow being illuminated by the candle alone, the latter by the light coming through the inch hole in the window-shutter.

The experiment on sunlight of last Friday (8th December) showed, at one o'clock on that day, the sunlight reaching the author's house in the University, to be of such brilliancy that the amount of it coming through a pin-hole in a piece of paper of ·09 of a centimetre diameter produced an illumination equal to that of 126 candles. By cutting a piece of paper of such shape and size as just to eclipse the flame of the candle and measuring the area of the piece of paper, he found about 2·7 square centimetres as the corresponding area of the flame. This is 420 times the area of the pin-hole and therefore the intensity of the light from the sun's disc was equal to (126×420) about 53,000 times that of a candle flame. This is more than three times the value found by Arago for the intensity of the light from the sun's disc as compared with that from a candle flame.

* Sometimes wrongly called the sense of touch. The true list of the senses first given, I believe by Dr. Thomas Reid, makes two of what used to be called the sense of touch, so that instead of the still too common wrong-reckoning of five senses, we have six, as follows:—

Sense of Force.
" Heat.
" Sound.
" Light.
" Taste.
" Smell.

PROFESSOR A. G. BELL'S EXPERIMENTS.—We are indebted to the courtesy of Professor A. G. Bell for advanced proofs of a most interesting paper read before the American Association for the Advancement of Science, in August last, and which we commence in our following pages.

UPON THE ELECTRICAL EXPERIMENTS TO DETERMINE THE LOCATION OF THE BULLET IN THE BODY OF THE LATE PRESIDENT GARFIELD;

AND UPON A SUCCESSFUL FORM OF INDUCTION BALANCE FOR THE PAINLESS DETECTION OF METALLIC MASSES IN THE HUMAN BODY.*

By ALEXANDER GRAHAM BELL.

(A paper read before the American Association for the Advancement of Science, at the Montreal Meeting, August, 1882.)

THE subject of my present paper recalls a time of intense excitement and painful suspense. The long, weary struggle with the untimely death-wound—the prolonged suffering borne so bravely and well by the lamented President Garfield—must still be fresh in every recollection. The whole world watched by his bed-side, and hopes and fears filled every passing hour. No one could venture to predict the end so long as the position of the bullet remained unknown. The bullet might become safely encysted, but, on the other hand, recovery might depend upon its extraction. The search with knife and probe among vital and sensitive tissues could not be otherwise than painful and dangerous; and the thought naturally arose that science should be able to discover some less barbarous method of exploration.

Among other ideas the thought occurred that the bullet might produce some sensible effect in modifying the field of induction of a coil brought near the body of the President, and that the locality of the bullet might thus be determined without danger to the patient and without pain; for it is well known that induction can be powerfully exerted through the human body without producing any sensation whatever.

Upon the balancing of Induction.

The influence that is exercised upon induction by metallic masses has formed the subject of numerous experiments by different investigators; and the principle of balancing the effects of induction on one portion of a circuit by equal and opposite effects produced upon another portion has been utilised in nearly all such investigations.

The earliest form of induction balance for this purpose appears to have been devised in Germany by Prof. Dove,† about the year 1841, and a good description of it in the English language may be found in De la Rive's "Treatise on Electricity" (1853 edition, Vol. I., pp. 418-433).‡

Another and superior arrangement for the same purpose is the well-known induction balance of Prof. D. E. Hughes.§

The static induction balance of J. E. H. Gordon,|| though primarily intended for experiments upon specific inductive capacity, might also, perhaps, be employed in the same class of investigations.

My own attention was directed to the balancing of induction a number of years ago by the disturbing noises produced in the telephone by the operation of telegraphic instruments upon lines running near the telephone conductor. The difficulty was remedied by using two conductors instead of one, and by so arranging them with reference to the disturbing wires that the currents induced in one of the telephone conductors were exactly equal and opposite to those induced in the other. In this way an induction balance was produced and a quiet circuit secured for telephonic purposes. This method was patented in England in November, 1877, and during the whole winter of 1877-8 I was engaged in London upon experiments relating to the subject.

In the course of these researches I made frequent use of flat spirals of insulated wire, like those employed by the late Prof. Henry * in his experiments upon induction.

My method was to pass a rapidly interrupted voltaic current through one flat spiral while I examined its field of induction by means of another flat spiral connected with a telephone. The currents induced in the latter coil produced a musical tone from the telephone.

At every point in the field of induction it was found that by turning the plane of the exploring coil a position of silence could be obtained, and another of maximum sound, the two positions making a right angle with one another.

It was also noticed that when a position of silence was established a piece of metal brought within the field of induction caused the telephone to sound. This effect was most marked when the two flat spirals were in close proximity, and were arranged with their planes parallel, as shown in fig. 1.

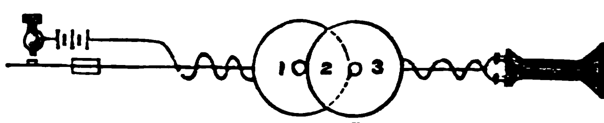


FIG. 1.

When a silver coin, such as a half-crown or florin, was passed across the face of the two coils, the silence of the telephone was broken three times. The instrument emitted a musical tone when the metallic disc passed the points marked 1, 2, and 3 in the illustration, but the loudest effect was produced when the coin crossed the area marked "2," where the two coils overlapped.

After my return to America I embodied these and other results in a paper "Upon New Methods of Exploring the Field of Induction of Flat Spirals," which was read before this association at the Saratoga meeting in August, 1879.

Practical Application.

While brooding over the problem of the detection of the bullet in the body of President Garfield, these experiments made in England returned vividly to my mind. It seemed to me that if the overlapping area, "2," of the two coils shown in fig. 1 could be brought over the seat of the bullet without disturbing the relative positions of the coils, the telephone would probably announce the presence of the bullet by an audible sound.

A crude experiment was at once made to test the idea. A large, single-pole electro-magnet (the core of which was composed of a bundle of fine iron wires) was used in place of coil A (fig. 1); and a small coil of fine wire taken from a hand telephone was arranged a little to one side of the pole to represent coil B. The small coil being connected with a telephone, a battery current was passed through the coil of the electro-magnet, and the battery circuit was made and broken by an assistant.

Under these circumstances a much better balance was obtained than could possibly have been anticipated. Upon now bringing a leaden bullet near the small coil, a distinct ticking sound could be heard from the telephone each time the battery circuit was made and broken.

Being absent from my laboratory, and without facilities for proper experiment, I communicated my ideas to Mr. Charles Williams, Jun., of Boston, manufacturer of electrical and telephonic apparatus, who kindly placed the resources of his large establishment at my service; and, at great personal inconvenience, delegated his best workmen to attend to my experiments.

Upon attempting to devise an appropriate form of apparatus for the special purpose in view, I saw that there were great practical difficulties in the way of utilising the arrangement shown in fig. 1, and it occurred to me that the apparatus of Prof. Hughes might perhaps be employed with more advantage as the basis of my experiments. In the ordinary form of Hughes' induction balance, four coils are used, as shown in fig. 2. Through the agency of a Hughes microphone, the ticking of a clock is made to create an electrical disturbance in the voltaic circuit containing the

* A preliminary notice relating to this paper was published in the *Comptes Rendus* of the French Academy of Sciences, Oct. 24th, 1881.

† Pogg. Ann. Vol. liv., pp. 305-335.

‡ A similar apparatus was independently devised in America a number of years ago by Prof. Rowland, of John Hopkins University. It is to be regretted that his discovery of the fact that he had been anticipated by Dove prevented Prof. Rowland from completing and publishing his researches.

§ Phil. Mag., July, 1879, Vol. ii., p. 50.

|| Phil. Trans. for 1879, p. 417.

* Silliman's Journal, xxviii., 329; xxxviii., 209; xli., 117.

two primary coils, A C, and a corresponding disturbance is produced by induction in the two secondary coils, B D, connected with the telephone. If the connections are so arranged that the currents induced in the telephone circuit by the coils, A C, are in the same direction, the ticking of the clock is heard very plainly, but if they are in opposite directions no sound is perceived.

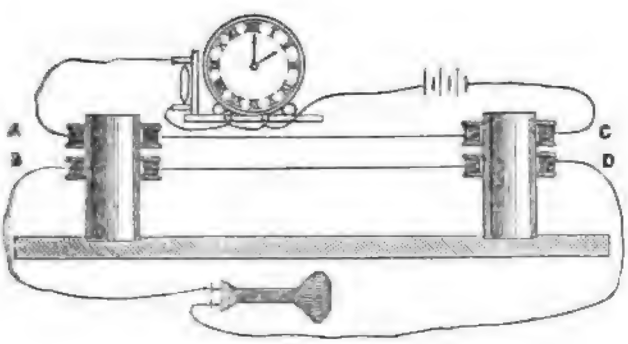


FIG. 2.

In the latter case the action of one primary coil, A, opposes that of the other, C, and an electrical balance results. If now a piece of metal is brought near one pair of coils, say, A B, the balance is disturbed, and the ticking of the clock is audible at the telephone. The arrangement of the coils, A, B, C, D, was the point to be studied, the microphone attachment being of no importance in the combination; for it is well known that a rheotome to break the primary circuit completely at intervals can be substituted for the microphone with advantage.

It seemed to me that two of the coils, A B, in the Hughes induction balance might be attached rigidly to a wooden handle, so as to be moved over the seat of the bullet without changing their relative positions, and that all the adjustments necessary might be made on the other pair of coils, which need not be moved from their place, and would not, therefore, be liable to disarrangement. If a single pair of coils were to be used, as in fig. 1, they must be adjustable one upon the other. But if during the course of exploration the coil B, fig. 1, should be moved from its proper position, even to the extent only of a small fraction of a millimetre, the balance would be disturbed and the exploration might have to be stopped in order to adjust the apparatus. These considerations led me to the conclusion that some modification of the Hughes induction balance was most suitable for my purpose, and I immediately commenced the construction of such an apparatus.

Suggestions Tested.

Just at this time I learned from the newspapers that Prof. Simon Newcomb, of Washington, had the idea of using a magnetic needle to indicate by retardation of its rotation the proximity of the bullet in the body of the President, and I telegraphed to Prof. Newcomb the offer of my assistance in carrying on experiments, knowing the comparative difficulty he would experience in having apparatus made in Washington.

At his suggestion I tested the point whether the rotation of a leaden disc and of a leaden bullet underneath a delicately-suspended magnetic needle would cause a deflection of the needle.

The disc occasioned a deflection, but the bullet produced no sensible effect. I telegraphed the result to Prof. Newcomb, and at the same time took occasion to inform him of the hopeful results I had obtained with the crudely-constructed induction balance referred to above.

I was much gratified by his immediate appreciation of the experiment. He telegraphed that he thought an induction balance promised a much more hopeful solution of the problem than his own method, and encouraged me in every way to continue my experiments.

This appreciation determined me to proceed to my laboratory at Washington, where I was accompanied by Mr. Sumner Tainter, who was anxious to assist in such a cause. I from Prof. Newcomb that Mr. Geo. M. Hopkins, of , had independently suggested the use of Hughes' induction balance, and had made experiments in Brooklyn, the results of which were published in the New York *Tribune* on the 11th of July, 1881. Mr. J. Stanley Brown (private secretary of President Garfield) kindly handed to me the letters he had received from Mr. Hopkins, and also a Hughes induction balance like that shown in fig. 2, which Mr. Hopkins had forwarded to the Executive Mansion for trial.

This apparatus was at once tested in my laboratory, with results slightly better than those I had obtained in Boston.

My Boston apparatus did not give a greater hearing distance than 3 cm., whereas with the Hopkins apparatus I could distinguish effects at a distance of 3·75 cm.

Two of Mr. Hopkins' coils (A B, fig. 2) were then fastened upon a wooden handle to form an exploring instrument, and the whole apparatus was arranged for immediate use in case of any necessity arising for an experiment upon the President. I set myself in communication with Mr. Hopkins, and requested his assistance and co-operation, and in reply received through Private Secretary Brown the following account of further experiments:—

60, IRVING PLACE, BROOKLYN, *July* 16*th*, 1881.

MR. J. STANLEY BROWN.

Dear Sir,—I have made two new instruments on plans differing from that sent, but they yield no better results. The first consisted of two oblong coils arranged at right angles to each other, thus:—

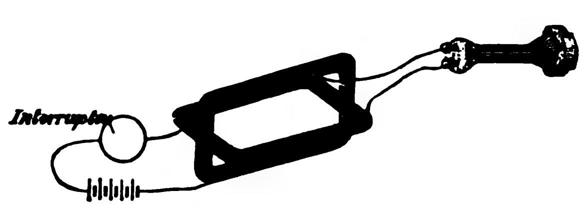


FIG. 3.

The outer coil being of coarse wire (No. 18), placed in the primary circuit, the inner coil being of very fine wire (No. 36), and connected with a telephone. The parallel currents traversing the wires neutralised each other, and no audible effects are perceived in the telephone, but on presenting a metallic body to the instrument upon a line bisecting the angle between the coils the clicking in the telephone is heard.

This instrument possesses only one advantage over that sent, and that is that it requires no adjustment.

The other instrument consists of two large coils of very fine wire (No. 36), placed upon opposite sides of a coil of coarse wire (No. 16), the fine coil being connected so that the induced currents neutralise each other, thus:—

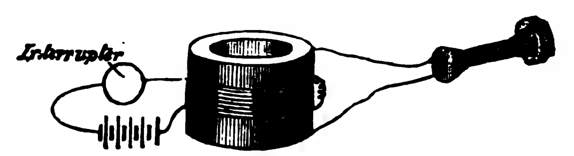


FIG. 4.

I am sorry to be obliged to say of this as of the other, that it is no more sensitive than the one sent. To produce the best effects from the instrument which you have it will be necessary to use all the battery power possible without burning the coils, and two receiving telephones of the best construction must be used.

As I stated in the first instance, if the ball is more than two inches deep, I think it cannot be located by this means.

If larger coils were used the instrument might be operative at a greater distance, but the area indicated as containing the ball would be so large that the result would be indefinite and without value.

Hoping that Prof. Bell will be able to succeed, I remain,

Yours very truly,

GEO. M. HOPKINS.

Prof. Hughes of London, England, Prof. Trowbridge of Harvard College, Prof. Rowland of John Hopkins University, and other authorities were consulted by telegraph as to the best theoretical form of induction balance for the purpose required, while empirical experiments were being carried on under my direction in my laboratory at Washington by Mr. Sumner Tainter; in the electrical work-shop of Davis and Watts in Baltimore, by Mr. J. H. C. Watts, and in the establishment of Mr. Charles Williams, Jun., in Boston, by Mr. Thomas A. Gleason. To test the influence of size of coil an instrument was constructed, in which the coils were no larger than the bullet for which he sought (as had been

suggested by Prof. Newcomb), and experiments were also made with the enormous coils used by the late Prof. Henry in his researches upon induction, which were kindly lent to me for the purpose by the Smithsonian Institution, but neither the small nor the large coils produced more satisfactory results than those we had already obtained.

To test battery power, 20 enormous Bunsen elements, which had formerly been used to light the gas at the capitol, were placed at my disposal by Mr. Rogers, the electrician of the capitol, but while great electromotive force was evidently of use we derived no advantage from such a battery as this.

To test the influence of speed of interruption, Mr. Marean, Superintendent of the Western Union Telegraph Co. in Washington, kindly lent us an electric-motor, by means of which we were able, with the aid of a rotating commutator, to obtain interruptions of the primary circuit of all rates up to 600 interruptions per second,* and we found that the more rapid the rate of interruption the more distinct was the sound in the telephone. The hearing distance, however, was not proportionately increased. The automatic interrupter (shown in fig. 5), yielding about 100 interruptions per second,

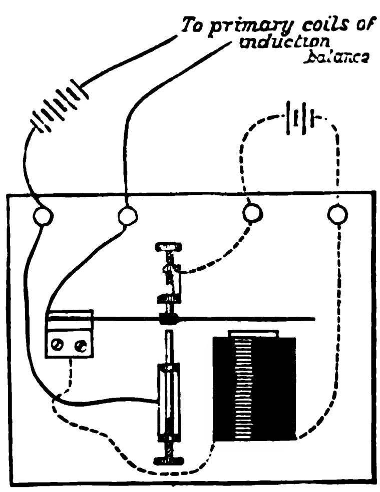


Fig. 5.

gave as good results as any, and was much more convenient. This interrupter was, therefore, afterwards used exclusively in our experiments.

The theoretical form of coil suggested by Prof. John Trowbridge was substantially the same as that proposed by Prof. Rowland, and is shown in fig. 6.

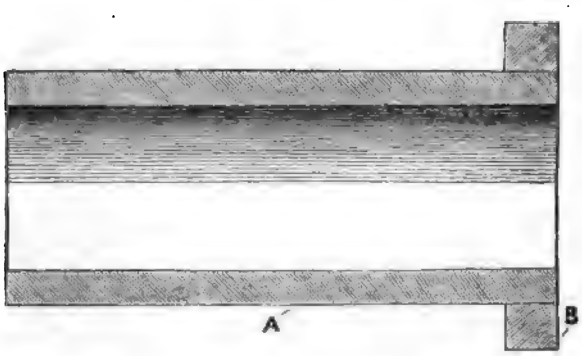


Fig. 6.

The arrangement was quite sensitive to metal placed in the interior of the coil, but the hearing distance for a bullet external to the coils was no greater than before.†

Prof. Hughes proposed to have two flat superposed coils wound on a single reel, so that the two coils should form a single one as regards their relative distance; and Mr. F. T. Bickford, Washington correspondent of the *New York Tribune*, suggested winding two wires side by side into a single coil, so that the relative distances of the wires from the bullet should be absolutely the same. M. Chas. E. Buell and Dr. Chichester A. Bell proposed to determine the depth of the bullet beneath the surface by causing a similar bullet to approach the balancing coils until silence was restored; the secondary bullet, it was presumed, would then be at the same distance from the balancing coils as the embedded bullet from the exploring coils.

The results of all the experiments so far made were unsatisfactory. I had tried everything that had been suggested, but 4 cm. remained the extreme limit of audibility for a bullet like that which had struck the President. Even when such a bullet was flattened by being fired against a board, and was presented with its flat side towards the coils of the explorer—the most favourable mode of presentation—no better result was obtained.

(To be Continued.)

* Mr. Sumner Tainter has since made an apparatus operating in a similar manner by means of which he has obtained as many as 4,000 interruptions of the circuit per second.

† The balance obtained was not quite perfect, and we have since discovered that the insulation of the wires of one of the secondary coils was defective.

THE INSTITUTE OF PATENT AGENTS.

(Incorporated 1882.)

Address of J. H. JOHNSON, Esq., President.

[Delivered at the Inaugural Meeting, November 29th, 1882.]

Gentlemen,—You will probably think it due from me—elected, as I have been, to the honourable post of first President of our Institute—that I should say a few words at what, I hope, will be the commencement of a long series of annual meetings.

In the first place, I must express my sincere thanks for the great honour which has been done me, and I trust that the Institute will have no ground, during my tenure of office, to regret the choice which it has made.

The Institute of Patent Agents has been in the minds of some of us for many years. Probably there is no profession which has more need of such an institution. You are aware that the objects for which the Association is established are:

Firstly:—To form a representative body of the Patent Agents of the United Kingdom for the purpose of promoting improvements in the Patent Laws and in the regulations under which they are administered;

Secondly:—To frame and establish rules for the observance of Patent Agents in all matters appertaining to their professional practice; and,

Thirdly:—To extend their opportunities and facilities for meeting, correspondence, discussion, and interchanging ideas respecting matters connected with their professional practice, and generally to aid in the acquisition and dissemination of knowledge appertaining to their profession.

The Institute is to be composed of Fellows, Associates, Foreign Members, and Honorary Members, with a class of Graduates.

The first Fellows of the Institute are the gentlemen who joined it on its formation; including, I think I may fairly say, all the prominent Patent Agents of the day, both in London and in the country.

For the future, a Fellow must be more than twenty-five years of age, and must come within one of the following conditions:—

(*a*) He shall have practised on his own account in the United Kingdom for at least five years, and have acquired good repute in the profession of a Patent Agent; or,

(*b*) He shall have been, for at least seven years, engaged as a pupil or assistant in the business of a Fellow of the Institute, and have acquired such knowledge as to qualify him to practise as a Patent Agent; or

(*c*) He shall have passed an examination in Patent Law and practice in mechanical drawing and in such technical or other subjects as the Council may deem requisite; such examination being conducted by the Council, or by examiners appointed by them.

Associates are to be persons of more than twenty-five years of age who are not Patent Agents by profession, but who, by their connection with the law, science, or the arts, are, in the opinion of the Council of the Institute, qualified to advance the objects of the Institute, or shall be persons who have been graduates of the Institute of three years' standing.

Foreign members shall be Patent Agents established in practice in foreign countries or the British Colonies, and neither having an office nor practising in the United Kingdom.

Honorary members are to be distinguished individuals who, from their position, are enabled to render assistance to the profession.

Graduates are to be persons not under eighteen years of age, who are or have been pupils or assistants of Fellows of the Institute, and have the intention of becoming Patent Agents.

Fellows are to be proposed, in writing, by a Fellow of the Institute, and recommended by four other fellows.

Fellows may also be admitted to the Institute by examination, in which case they must be proposed by one fellow and seconded by another.

A member may be passed from the class of associates to the class of fellows at a general meeting of the Institute.

Foreign members and honorary members must be proposed by the council, and their names submitted for election by ballot, as in the case of fellows and associates.

I need not trouble you with the further steps to be taken with respect to the election of various classes of members; they can always

be ascertained on application to the Secretary of the Institute; but with regard to the fees payable, I may state that:—

Fellows are to pay an entrance fee of six guineas, and an annual subscription of four guineas.

Associates an entrance fee of three guineas, and an annual subscription of two guineas.

Foreign members an entrance fee of two guineas, and an annual subscription of one guinea.

Graduates an entrance fee of one guinea, and an annual subscription of one guinea.

The affairs of the Institute are to be managed by a council chosen from among the fellows only, and consisting of one president and one vice-president, of eight ordinary members of council, and of the past presidents.

It will be seen that the present list of the council comprises the names of members of most of the principal London firms, and of one patent agent residing in Glasgow, and one residing in Birmingham.

It is quite probable that some Patent Agents entitled to admission to the Institute have not been invited to assist in its formation. We wish it to be understood, as to any such gentlemen, that their non-inclusion in the first list of members is no slight on them, and that the council do not profess to have invited the co-operation of all qualified practitioners, but only of those with whom some member of the council was acquainted. They considered it necessary in the first instance, to adopt this method of procedure, as no other means of selection appeared to be open to them. The council could not undertake the personal responsibility of approving every name they heard of as that of a Patent Agent without knowing anything whatever of the position or qualifications of the person referred to. It was, therefore, deemed best to invite the assistance of a sufficient number to form a nucleus for electing applicants in accordance with the formalities prescribed by the regulations. The course they have followed has been prompted solely by regard for the interests of the Institute, and has not been in any sense attributable to a desire to exclude any Patent Agent who can be regarded as properly qualified for admission. On the contrary, they will be happy to receive applications for admission from gentlemen practising the profession who are not yet members.

The moneys of the Institute are to be entirely devoted to the promotion of the objects for which it was formed: but I am afraid that its funds—at all events during its early stages—will scarcely do more than pay the current expenses which it is absolutely necessary for the Institute to incur.

Our idea in forming the Institute of Patent Agents has been that it will be useful in making us better acquainted with each other on the ground of common interest, and in facilitating discussion on all questions of interest to patentees and to ourselves. There are frequently questions arising of great moment to our clients upon which an individual agent can exert but little influence; and it is hoped that this Institute will be able to deal with such questions with an authority no individual member could hope to possess.

Much good has been done by professional institutes founded, like ours, for the purpose of drawing together the members of the profession, and for extending their opportunities and facilities for meeting, correspondence, discussion, and for the interchanging of views connected with matters relating to their professional practice.

I need only refer you to the Law Institution (which has done much to elevate the status of solicitors), the Institution of Civil Engineers, the Royal Institute of British Architects, the Institute of Surveyors, and the Institute of Chartered Accountants. All these bodies number a great many more members than we do at present, or are likely to do, but the profession of a Patent Agent, properly carried on, relates to as important a class of interests, and requires the possession of as great a degree of trained skill and aptitude, as do the professions represented by the institutes to which I have referred. The Institute will, we trust, give us a greatly improved status; and we look forward to the time when our Institute will have as important an influence on our profession as the institutes referred to have in the professions to which they relate.

The profession of a Patent Agent has not been carried on as a separate branch of business, in this country, for more than sixty years.

My own personal knowledge of it extends to a period of something like thirty-three years.

Prior to the passing of the Patent Law Amendment Act, 1852, Patent Agents' business was of a comparatively limited character. The number of patents annually taken out in England, at that time, not amounting to more than 550; but the Patent Law Amendment Act was the precursor of an entirely new era in the profession. The number of patents was greatly increased, and there was also a very great increase in the number of patents applied for by British subjects in foreign countries.

I need scarcely remind you that, prior to the Patent Law Amendment Act, the British patent covered our Colonial possessions; but, as it was decided that the British patent should not, from that time, extend to the British Colonies, nearly every Colony of importance has now passed a Patent Law of its own, and the number of Colonial patents has vastly increased. This has greatly extended the sphere of operations of Patent Agents and has necessitated the establishment of agencies in all the important Colonies.

Much has been said of late years with regard to the number of patents taken out in this country as compared with the number taken out in the United States. The fees in the United States are no doubt very much lower in amount than they are in this country; but it must be remembered that it is absolutely necessary, in the United States, for an inventor to take out separate patents for a number of heads of the invention, which may all be covered by one patent in this country; and that, when there are conflicting applicants for the same invention, the cost of the American patent is enormously increased.

I believe that, on the whole, the Patent Law Amendment Act has worked very successfully for British inventors. Of course, we all of us know that there are many points in it which might very well be amended, and I cannot help thinking that one great blot in our Patent system consists in the fact that numerous patents are granted, upon mere application, for inventions which any man of intelligence must know to be perfectly old. It therefore appears to me that any Act to amend the Law of Patents should certainly contain some provision with respect to the examination of the applications, and that the applicant should, at least, have pointed out to him by the Patent Office the specifications of similar inventions which are already existing in that office.

It is not possible, in the limited time at my command, to go into any details as to the mode in which such an examination should be conducted, or the principle upon which applications should be rejected. It is sufficient at present to draw your attention to the question—which is certain to be brought forward whenever Parliament can afford time to take up Patent Law reform.

It may be well, therefore, that we should give the matter our serious consideration beforehand, so as to be prepared to deal with it at the proper time.

Various Bills which have been brought before Parliament for the last ten or twelve years have all received the close attention of a Committee of Patent Agents sitting in London, and their recommendations have, from time to time, been brought before the gentlemen in charge of the several Bills, the Law Officers of the Crown, and the Lord Chancellor. It may not be irrelevant here to state that our suggestions have always met with courtesy, and we have found many of these suggestions adopted in Bills of a later date. The Bill which appeared most likely to meet the views of inventors, and to be of most advantage to this country, was the one brought in by Sir John Holker in the year 1879; and the Patent Agents to whom I have before referred were in great hopes that the Bill, with some modifications, might pass, as it would have been a great advance on the present state of legislation on the subject. The Bill was, however, blocked in the House of Commons, and it is to be feared that inventors will find some difficulty in getting the Government again to look upon their interests with the same liberal view they did at that time. You are aware that the Government proposed to bring in a Bill for the Amendment of the Patent Laws last year, but the state of business in Parliament clearly prevented their dealing with the subject. It is now understood that the Board of Trade have a Bill under their consideration, and that it is to be introduced as soon as there is any chance of its obtaining proper discussion. When that Bill is introduced it will be one of the chief duties of the Institute to keep the closest watch upon it, and upon all Bills that may come before parliament on the subject; to do our best to point out where they are faulty, and how they may be improved. The Bills we have hitherto seen all contain provisions more or less crude, more or less impracticable, and more or less dangerous to the interests of inventors. For instance, I cannot help thinking that every plan for making licences compulsory is unworkable, that the patentees and the public should be left free to settle their business in their own way, and that any attempt to interfere with them will be entirely abortive and will do more harm than good.

As to these and other questions relating to the same important subject, it must be manifest to all that the suggestions of our Institute, founded on the mature deliberations of the body of Patent Agents, will have much more weight than those of individuals.

Here and there we meet with persons who preach the doctrine of "No Patents"; but I firmly believe that so long as Government deems it just and expedient to give copyright to authors it will extend patent right to inventors.

I shall not waste your time by arguing on this point, feeling convinced that every one who hears me knows that it would be the height of injustice to deprive the inventor of the fruits of his labour.

It is intended to hold at regular intervals meetings of the Institute, at which papers will be read by members on subjects of interest to the profession. It is hoped that these meetings will also afford the opportunity for discussing questions relating not only to procedure and practice in this country, but in foreign countries and in the Colonies, where the interests of patentees are now becoming of great importance.

The Institute will also afford opportunities for prompt intercommunication of legal decisions in patent cases. It may probably be possible to arrange for the communication, to the Institute, of all legal decisions of importance, considerably in advance of the publication of such cases in the ordinary law reports, whilst decisions in matters of practice before the law officers (as to which there is often much obscurity) may also, with great benefit to the profession generally, be brought to the knowledge of the Institute by the members engaged.

Patent Agents are accustomed to be consulted by inventors, not only on the policy of securing their inventions by letters patent, but upon their commercial dealing with the inventions after they are protected; and our clients are entitled to expect from us the most honourable and straightforward advice. One part of our duty is to restrain them from rushing into litigation when their patents afford no fair grounds for such a course. We all know that the inventor has an extreme idea of the value of his own invention; and we can all repeat instances of clients who cannot understand that the consideration of their particular invention is not the most important subject of the moment.

Patent Agents are also very frequently in a position of much delicacy as regards the claims of rival inventors, through the feeling of jealousy which one inventor has of another. I believe that where the Patent Agents employed are men of honour and position, there is little ground for any jealousy of this kind. I have frequently found that the knowledge I possessed of rival inventions and rival inventors, which was confined to my own office, has been of great benefit by enabling me to warn subsequent inventors of dangers they might otherwise have rushed into.

There has also been considerable difficulty at all times in the selection of proper scales of charges for procuring patents and for other services in relation to patents; but I think the members of an institute of this kind may, by communication with each other, agree on what should be fair to themselves and to their clients. This subject is a kindred one to that of the charges of solicitors, as to which there has also been much recent discussion, finally concluded by an Act of Parliament in the preparation of which the Law Institution had no small part.

It is our great wish to do everything that can be done to maintain the honourable position of Patent Agents, and to give them a place in the estimation of the public, which has scarcely yet been fully attained. If this Institute can attain the position of a central authority, we shall do much to effect the objects I have mentioned; it being our desire, on the one hand, to provide a check against all irregularities in professional practice, and, on the other hand, to secure to the members of the Institute that fair consideration from their clients to which they are entitled.

The council have power, by the articles of association, to exclude from membership of the Institute all persons convicted of any irregularity in the practice of patent agency. The members may rely upon it that no part of the duties of the council will be more onerous or more unwillingly undertaken; and it is hoped that there will be few, if any, cases in which this authority has to be exercised.

You will observe that we have taken power to admit, as members of the Institute, Patent Agents practising in the different foreign States. We shall be in constant communication with these agents; and I cannot help thinking that much may be done to facilitate the labours of English agents by a well-arranged system of such correspondence.

We look forward to the time when we may collect a library that shall be valuable to our members and to all interested in patents in this country; but we may be some time in attaining this object, owing to the expense that must necessarily be incurred in the formation and preservation of such a library.

The council will be, at all times, willing and desirous to receive communications from agents upon all subjects connected with the objects of the Institute and the well-being of the profession; and as we shall meet at frequent intervals, all such communications will have our most careful consideration.

The selection of a competent person to fill the office of secretary has been a matter of considerable difficulty and anxiety to the council. The development of the Institute must necessarily depend to some extent on the ability and energy of this officer. It will be essential that the existence and importance of the Institute, and the qualifications necessary for admission thereto, be made widely known; otherwise influence cannot be acquired for itself as a body or for its members individually. The labour involved in securing these results will principally devolve on the Secretary, in addition to the routine business of the Institute. The council believes that the gentleman selected (who has had considerable experience in the formation of other institutions) possesses the qualifications necessary for the effective fulfilment of the duties of the office.

Having put before you, Gentlemen, the objects and interests of this Institution, it is only for me to say that our success can only be assured by the hearty co-operation of all its members; and this, I hope, we are already assured of, as the formation of an institute of this kind seems in itself a proof that the members are desirous of effecting the objects I have pointed out.

THE EXPERIMENTS OF MIESBACH-MUNICH.

Epilogue.

The fact which has just transpired at the Société Française de Physique shows that we must give up all hope of the last word about the experiments on the transmission of power to a distance between Miesbach and Munich, the results of which have been so much exaggerated, with an object which is easily understood.

We give further on an extract from the *Comptes Rendus*, of the sitting of December 1st, 1882, which will throw a curious light upon this mysterious affair, and which will show how much reason we have to suspect the return of 68 per cent.

We have not here to defend or to criticise the mode of calculation adopted by M. Cabanellas, but only to establish the authenticity of the figures which have served for the foundation of the discussion.

Now, M. Cabanellas borrowed these figures from the *Bulletin de la Société Générale des Téléphones*, who held them from M. Sarcia. M. Cabanellas communicated his work to Dr. Von Beetz, the manager of the Munich Electrical Exhibition, and on October 28th, Dr. Von Beetz replied to M. Cabanellas in a letter which, at our request, the recipient was kind enough to send to us, and from which we extract the following passage:

Sir, —I hasten to thank you for your extreme kindness in sending me your publications and the reports in manuscript. Being still occupied with the electro-technical measurements which form the basis of our exhibition, I have only, up to the present, found time to read the letter. It is with the greatest interest that I have followed your calculations, which seem to me as convincing as simple. As to the results obtained by M. Deprez, it is impossible to come to definite conclusions from them. The provisional figures which you have employed are those which M. Deprez found (see the continuation in the *Compte Rendu*, of the sitting of the *Société Française de Physique*, at the end of this article).

Notwithstanding this unequivocal assertion of Dr. Von Beetz, M. Marcel Deprez continues to deny *a part* of the figures given in the *Bulletin de la Société Générale des Téléphones* and confirmed by the manager of the Exposition de Munich. The explanation of all these contradictions and denials is not perhaps so difficult to find as one would think at first. In the first moments of material success figures were quoted somewhat at random, without even taking the trouble to consider the conclusions which might be drawn from them, and without inquiring whether they showed a sufficient concordance among themselves. But as *"tout mauvais cas est niable,"* according to a French proverb, it is found simpler to deny them when they are compromising.

We shall return no more to the experiments of Miesbach-Munich, for Dr. Von Beetz has summed up their extent in these conclusions which shall be also ours:—

It is impossible to draw definite conclusions from the experiments of M. Marcel Deprez.

The only experiments which the committee were able to make before the destruction of the machines furnished mechanical returns of 23 and 32 per cent.

It will be necessary to wait before deciding for or against until M. Marcel Deprez shall have repeated his experiments upon a larger scale.

E. H.

Société Française de Physique.

(Extract from the *résumé* of the communications made at the sitting of December 1st, 1882, under the Presidency of M. Gernez.)

After the reading of the official report of the sitting of November 17th, the President communicated two letters which had been addressed to him, one by M. Sarcia the other by M. Deprez.

M. Sarcia wrote that, "1st, The figures upon which M. Cabanellas supported his calculations are erroneous, as he says; 2nd, The authenticity of the figures which he has disputed is by no means established by the letter of M. Beetz where they are not to be found; 3rd, He did not say that the Carpentier brake included the frictions and passive resistances, but quite the reverse."

M. Deprez complains of the partiality with which the minutes have been drawn up; of the omission in the report of the numbers employed by M. Cabanellas; lastly, of the non-insertion of the letter of Dr. Von Beetz. He adds that in consequence of these facts he has resolved to cease from this moment to belong to the Société de Physique.

M. Gerout disputed that the conclusions can be drawn from the letter of Dr. Von Beetz which M. Cabanellas deduces from it.

Upon this occasion the President thought proper to remark that the *rôle* of the Bureau in the publication, necessarily much abridged, of the report, is simply to reproduce with all possible accuracy the ideas expressed by the persons who had the honour of speaking before the society, leaving to each the entire responsibility of his opinions and not feeling called upon to decide between contradictory opinions or assertions.

Mention will be made in the report of the claims of Messrs. Sarcia, Deprez, and Gerout.*

Resistance of each of the machines	470 ohms
Resistance of the telegraphic circuit ...	950 ,,
Speed of the generator (Miesbach)	2,100 revolutions
Speed of the receiver (Munich)	1,400 ,,
Difference of potential at the terminals of the generator	2,400 volts
Difference of potential at the terminals of the receiver	1,600 ,,
Current intensity	0·5 ampères
Work	37·5 kilos.

The point was declared settled and the report adopted.

* In compliance with the request of M. Deprez, the Bureau thought proper to give in a note the numbers which served as the foundation of the discussion and an extract from the letter of Dr. Von Beetz.

(Extract from a letter from Dr. Von Beetz to M. Cabanellas.)

"MUNICH, October 28th, 1882.

" . . . The provisional figures which you have employed are those which M. Deprez had found. The Committee commenced by measuring the constants of the machines and of the circuit, at first at 1,600 revolutions of the generator. A mechanical return of 23 per cent. was obtained, and at 2,000 revolutions 32 per cent. But suddenly one of the brushes fell, and the induced current produced by this interruption destroyed the fine wires in both machines.

"Now we have not yet obtained the exact figures; we must wait until M. Deprez has repeated his experiments on a larger scale. Until then I shall pronounce no personal opinion either for or against."

PROCEEDINGS OF SOCIETIES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, December 14th, Lt.-Col. WEBBER, R.E., President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members announced, the annual report of the Council of the Society was read by the secretary.

During the past year the numbers of the Society had been increased by the election of 9 foreign members, 10 members, 74 associates, and 7 students, or a total of 100. In addition to the foregoing, 5 new candidates would be balloted for on the present evening, and 39 on the next meeting. The Society had, on the other hand, lost by deaths 5 honorary members, 10 members, and 17 associates, amongst whom were Capt. Gill, Mr. Hockin, Mr. Laws, and Mr. Schwendler. The Institution of Civil Engineers had, with great kindness, continued to grant the use of the lecture hall for the purposes of the Society. The Secretary then read a list of the papers which had been brought before the Society during the year. In the *Proceedings* of the Society would be found a large number of original communications of great interest. The General Index to the first ten volumes of the *Proceedings* had been completed. The entertainment given at Chatham at the School of Engineering of the Royal Engineers was next alluded to. It was also pointed out that during the year an International Congress had been held at Paris, and also Electrical Exhibitions at Munich and at the Crystal Palace, and that a further exhibition was to be held at the Royal Aquarium at Westminster. During the last year a very large amount of capital had been subscribed for electric lighting enterprise, and, as a consequence, a very considerable amount of fresh information had been obtained on the subject. At the International Congress at Paris the subject of the protection of submarine cables had been fully discussed, and certain recommendations were drawn up, which had been submitted to the various Governments. The questions of the redetermination of the electrical units, lightning protectors, and the observation of earth currents, had also been considered.

The insurance companies having had to consider the liabilities to fire which arose from the use of the electric light, the Society had drawn up a code of rules, which was adopted by all the offices.

The surplus moneys from the guarantee fund for the late Paris Electrical Exhibition, amounting to £110, had been invested, and this, together with a grant from Mr. Fahie, enabled the Society to offer three annual premiums for papers read before the Society, of the relative values of £10, £5, and £5. It it hoped that these premiums will stimulate the younger members of the Society.

The gratuitous services rendered by the foreign secretaries were then mentioned.

The honorary solicitors to the Society had made application for the incorporation of the latter under the Limited Liability Act.

The finances of the Society were highly satisfactory. The life compositions, amounting to £741, will be invested in securities almost immediately.

The "Report of the Librarian" was next read. The number of visitors to the library was more numerous than during the previous year, but the evening attendance was small. The number of members who had signed the attendance book was 318; the number of non-members, 248; the total number of visitors, allowing for those who had not signed, was probably about 600. The Specifications of Patents were very much referred to and have been proved very useful. The thanks of the Society were due to Mr. R. Morris, of the Patent Office, for the prompt despatch each week of the newly published Specifications. The library had been increased by the addition of 245 new works, which was 80 more than last year. Most of the additions are gifts, but several works were obtained by purchase. In future it is intended that the names of the new volumes added to the library shall be announced at each ordinary general meeting. It is proposed to add books on physical science generally in addition to those on electricity purely. The Librarian, in his report, alluded to a suggestion which had been made by Mr. Kempe at a previous meeting, viz.: that the Electrical Patent Specifications should be indexed. This proposal, he considered, would be very useful if carried out. A classified index of the library would also be very valuable, as a catalogue of names alone often failed to enable a person to find a work on a particular subject. A great many applications were received for books treating on particular subjects, and it was difficult to pick these out. These suggestions would probably be worth the consideration of the council.

The usual votes of thanks to the Institution of Civil Engineers, the Foreign Secretaries, &c., having been proposed, seconded, and carried unanimously, a paper by Mr. T. J. LARKIN, Member, on "The application and Extension of Telephonic Communication in Japan," was read by the Secretary.

The use of telephonic communication for police purposes had never been considered in England, but in Japan it was carried into effect with great success. In one of the principal cities, containing 300,000 inhabitants, the police force had at first great difficulty in keeping order, consequently, in 1878, a telegraphic system with nine offices was introduced, worked by Morse printers. The wire used was of No. 11 gauge. On the invention of the telephone the latter instrument was substituted for the printers, and with great success, as the intermittence in the work with the ordinary instruments was much disliked by the operators, who were continually resigning their situations, causing great inconvenience. The Bell telephones were the instruments employed, and were worked by the police staff without difficulty. The first were purchased, but afterwards they were manufactured locally with perfect success. Four telephones on one circuit were employed in some cases, the stations being called up by so many strokes on a bell. One of the lines was eight miles long, and ran on poles with other working wires; although the inductive disturbance was very strong it did not prevent proper working. Experiments were subsequently tried on 57 miles of railway, with 17 stations, with every success, and it was finally decided to adopt the telephones for block as well as ordinary signalling. Several instances were given of the value of telephonic communication as compared with the ordinary telegraph system. By means of shackles placed on the poles at every mile, it would be possible, in case of a railway accident, for the guard to connect up a hand telephone and communicate with the nearest station.

A vote of thanks to Mr. Larkin having been proposed, seconded, and carried, the result of the balloting for the new Council for 1883 was announced as follows:

President—Willoughby Smith. Past Presidents—Charles William Siemens, D.C.L., LL.D., F.R.S.; Frank Ives Scudamore, C.B.; Sir William Thomson, LL.D., F.R.S.; Latimer Clark, M. Inst. C.E.; C. V. Walker, F.R.S.; Professor Abel, C.B., F.R.S.; Lieut.-Colonel J. U. Bateman-Champain, R.E.; W. H. Preece, F.R.S., M. Inst. C.E.; Professor G. C. Foster, F.R.S.; Lieut.-Colonel C. E. Webber, R.E., C.B. Vice-Presidents—Professor W. G. Adams, F.R.S.; C. E. Spagnoletti, M. Inst. C.E.; Professor D. E. Hughes, F.R.S.; Sir Charles Bright, M. Inst. C.E. Hon. Treasurer—Edward Graves. Hon. Secretary—Lieut.-Colonel Frank Bolton. Council—Members: W. S. Andrews; William T. Ansell; E. B. Bright; H. G. Erichsen; H. C. Forde, M. Inst. C.E.; J. Fletcher Moulton, F.R.S.; Alexander Siemens; Augustus Stroh; C. F. Varley, F.R.S.; Professor W. E. Ayrton, F.R.S.; T. Russell Crampton, M. Inst. C.E.; Dr. J. H. Hopkinson, M.A., F.R.S. Associate Members of Council—Lieut. Arthur H. Bagnold, R.E.; Shelford Bidwell, M.A., LL.B.; J. C. Lamb.

The meeting then adjourned till January 13th, 1883.

PHYSICAL SOCIETY.—DECEMBER 9th.

PROF. CLIFTON, President, in the chair.

New Members—Mr. H. E. HARRISON, B.Sc.; Mr. S. T. H. SAUNDERS, M.A.

Prof. G. FORBES read a paper on "The Velocity of Light of Different Colours." The author concluded, from his experiments described to the society a year ago, that blue rays travel quicker than red rays. M. Cornu had endeavoured to explain this result by peculiarities of the apparatus employed, but this explanation seemed doubtful. It was suggested that the experiments might be repeated with such modifications of the apparatus as would set the question at rest.

Profs. AYRTON and PERRY read a paper on "The Resistance of the Voltaic Arc; or, the Opposition Electromotive Forces set up." The E.M.F. was measured by a voltmeter connected between the terminals of the lamp. Keeping the width of arc constant, the E.M.F. was found to diminish as the current increased. Keeping the current constant, the E.M.F. increased rapidly at first with an increasing width of arc, and afterwards more slowly. The authors gave a curve representing the change. About 80 volts are required to produce an arc of $\frac{1}{8}$ in. For further increase of arc E.M.F. is therefore proportional to increase of length of arc.

The authors also read a paper on "The Relative Intensities of the Magnetic Field produced by Electro-magnets when the Current, Iron Core, and Length of Wire, &c., are constant, but the wire differently distributed." In *a* case the wire was wound uniformly from end to end; in *b* case it was wound from the middle to one end; in *c* case it was wound only at both ends; in *d* case it was wound only at one end. The field was measured along a line running through the axis of the poles beyond the magnet. Of the above plans, *a* gave the strongest field, except at short distances, when *b* was best.

Profs. AYRTON and PERRY also exhibited a set of three Faure accumulators in series feeding 20 Swan lamps, each lamp giving over 1 candle-power. The E.M.F. of each cell was about 2 volts.

Next meeting January 27th, 1883.

PHILLIPS *v.* THE GREAT WESTERN ELECTRIC LIGHT AND POWER COMPANY. (LIMITED).

THIS was an application in the High Court of Justice, Chancery Division, before Mr. Justice Chitty, by a shareholder of ten shares in the company for the rectification of the register of the company by striking out his name from the list of shareholders. It was stated in the prospectus that the company had secured a concession from the Anglo-American Brush Electric Light Corporation (Limited), under which the exclusive right of use or sale of their dynamo machines and arc lamps, together with an exclusive licence to use or sell the Lane-Fox incandescent lamp, was secured to the company for a considerable part of the West of England and South Wales. It was stated on behalf of the applicant that on the 20th of July, 1881, Mr. George Lane-Fox assigned to the British Electric Light Company the exclusive right of using and granting licences to use his inventions in Great Britain and Ireland, and that on the 29th of July, 1881, Mr. George Lane-Fox executed a similar assignment to the Anglo-American Brush Electric Light Corporation, subject, nevertheless, to the previous assignment of the 20th of July, 1881. It was contended that the statement in the prospectus with respect to the exclusive right of the company to use or sell the Lane-Fox incandescent lamp in the district named was incorrect. The applicant, without alleging any *mala fides* on the part of the company's promoters and directors, submitted that he was induced by what was in fact a false representation to subscribe for the shares in question.

The application was opposed on the ground that if a misstatement had been made, it was not material, since the Lane-Fox lamp was the least valuable of the inventions conceded to the company by the Anglo-American Corporation.

Mr. Justice Chitty said that it was plain to an ordinary mind that there had been a misstatement which was material and calculated to mislead the applicant. His Lordship also thought that it was not competent for persons who had issued a prospectus which had recommended as one of its leading attractions this particular invention to afterwards say that the invention was of little or no value. The application must therefore be granted with costs, and the sums paid in respect of the shares returned to the applicant by the company.

[We regret that the pressure on our space last week rendered it necessary to leave this matter over, more especially as a subscriber has since written to us asking for information.—EDS. ELEC REV.]

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

ELECTRICAL ACCUMULATORS.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—I was present to-night at a lecture, given under the auspices of the Limehouse Scientific Society, at the Town Hall, and, while profiting by the clear and concise manner in which the whole subject was treated, aided by a profusion of experiments with extensive apparatus familiar in principle to all of us, I was chiefly interested in the great success of the lecturer, Mr. Reckenzaun, in producing an efficient light of considerable power and duration from an arc lamp by means of a current furnished through accumulators of small proportions.

This, I think, must be the first time it has been successfully accomplished; at any rate, I have never yet seen it done at any lecture in a manner that could be so described; and I should esteem it a favour if Mr. Reckenzaun would see fit to oblige your readers with some explanation of his method.

I understood him to say that the accumulator was constructed on the lines of Messrs. Sellon and Volckmar, and it very efficiently provided current for a Pilsen arc lamp, a string of Swan and other incandescence lamps, driving also three different motors, of which the swiftest and most compact seemed to me to be one stated to be going at about 3,000 revolutions per minute, and, unless I misunderstood him, of the lecturer's own invention.

Yours truly,

London, 13*th December*, 1882. B. UNWIN.

[Some time since a "Pilsen" arc lamp was exhibited at Charing Cross, the current being supplied by Faure accumulators.—EDS. ELEC. REV.]

AN IMPROVED THOMSON REFLECTING GALVANOMETER.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—What I wished to point out with reference to the relative effects of different parts of the coil, and what I still maintain, is that the nearer the wire is to the needle the greater will be its effect for the same current. Surely it is

well known that in a tangent galvanometer, where the size of the coil is not only *not small*, but *very large*, "compared with the size of the space within which the needle swings," "the total result of all the turns" is *trebled* by adding one other turn of half the diameter of the first and putting it in series with it; and in my instrument, so far from getting only a "few extra turns set close to the needle," I would draw attention to the fact that *more turns* can be got in the *central* ⅜ of an inch than can be got in the *next* ⅜ of an inch diameter, as with very great propriety a smaller wire can be used.

With regard to the damping effect of the metal frame there is no reason, when a ballistic galvanometer is required, why this may not be omitted; but no one would dream of using such an instrument for ordinary work, or of using any ordinary reflecting galvanometer for taking discharge deflections, if anything approaching accuracy were required.

Yours truly,
December 13*th*, 1882. F. J. MUDFORD.

[With reference to the last paragraph in Mr. Mudford's letter we would point out that the writer is quite in error in supposing that "no ordinary reflecting galvanometer would be used for taking discharge deflections if anything approaching to accuracy were required." As a matter of fact the ordinary reflecting galvanometer is always so used in every cable factory and in every laboratory which possesses such an instrument, and perfect accuracy can be and is obtained by the methods well known and always used by every electrician who knows anything of his work. We are not aware that "it is well known that...... the total result of *all* the turns is trebled by adding *one* other turn of half the diameter of the first, and putting it in series with it." It is well known that "the effect of *one* particular turn is trebled by adding *one* other turn of half the diameter of the first and putting it in series with it," which is a very different thing. As we stated, we quite appreciate the value of the new galvanometer, but as regards the two points in question we think they do not possess the advantages claimed.—EDS. ELEC. REV.]

PERSONAL.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I find that an impression prevails that I am connected with the J. B. Rogers Company on the Viaduct. Will you kindly permit me to say that I am in no way, directly or indirectly, connected with this or any other company, and that my only place of business is still, as it has been for some years past, at 21, Finsbury Pavement?

Yours faithfully,
FRANCIS M. ROGERS.
21, Finsbury Pavement, *December* 16*th*, 1882.

CONTINUOUS ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Seeing the article in this day's Review concerning the Edison lights having been kept running continuously for 64 hours, and also that this has never before been accomplished in England, I beg to inform you that I have a 40 arc light "Brush" machine, and a 60 incandescent light Siemens alternating current machine, running here regularly from 6 a.m. on Monday morning to 10 p.m. on Saturday night. It has been found necessary to stop occasionally (about every twelve hours) for a few minutes for oiling and for cleaning the machine, but notwithstanding, I think you can hardly help agreeing with me that this is about the most severe test that any electric light machinery has yet been put to, considering that the Edison Company used two machines, and here there is only one.

I am, dear Sirs, yours truly,
N. MACADAM.
Severn Tunnel Contract, Portskewett, Mon.,
December 16th, 1882.

ELECTRO-MOTORS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—If you should think the followin[g of suffi]cient interest to your readers kindly give it a pl[ace in the] pages of your journal, of which I am an old subs[criber].

I went last Monday to hear the Cantor lecture of Prof. Silvanus Thompson on electro-motors at the Society of Arts, in the hope of learning something as to any rules and standards by which to judge the merits of a motor. I must confess that I was disappointed; but with the recent rather protracted controversy fresh in my memory which took place amongst noted electricians as to the value of the results arrived at in the now celebrated experiment at Munich, where the opinions differed so widely, and considering that in cases where the dynamo and motor are not identical, the subject must necessarily be still more involved, I was, perhaps, unreasonable in expecting something definite.

There was much that was interesting and valuable in the lecture, and would have appeared to me more valuable still had I been able to bring myself to have more faith in the very principles as laid down by the lecturer upon which he based his deductions as to efficiency of motors. He gave us an outline of the difficulties early inventors experienced. Seeing that when the motor worked the current diminished, they attributed it to an increase of resistance. He said we knew better now, and that the diminution of current was due to a counter E.M.F. set up in the motor and opposing the current. We were told that, calling the E.M.F. of the whole circuit E and the counter E.M.F. e, $E - e$ was energy lost as far as production of mechanical energy was concerned, and the e was, in fact, the measure of the motor's efficiency. As the current diminishes in proportion as e increases, e being a function of speed, the motor would be at its greatest efficiency when the current had ceased altogether.

Now, the efficiency of a dynamo machine is determined by the proportion of electrical energy it produces as compared with the power employed in driving it. A motor, a machine intended to re-convert electrical into mechanical energy, is, we are told, at its highest efficiency when it drives nothing—that is to say, when it does not perform its proper functions. This is an anachronism, to say the least of it. Is the term "efficiency" to have a different meaning in motors to what it has in dynamos? It seems to me very unlikely that rules and standards for comparing relative merits of motors can be constructed upon foundations such as this.

Again, as to the term "counter E.M.F." Either it is unfortunately chosen—meaning something else to what it expresses—or the nature of the force set up in the motor is misunderstood.

A comprehensive counter E.M.F. would be generated in the motor if it was forced the opposite way to its proper motion. This force might be made so great as to entirely destroy the original current, and even to reverse it. But how a force set up in a motor, when it is urged round by a current, and which is evidently of the opposite nature to that just mentioned, can also be termed a counter electromotive force, passes my comprehension.

In fact, a very simple experiment proves at once that there is no counter E.M.F. set up at all. Putting a motor into a circuit and introducing any suitable tension-meter between the brushes as a shunt, the deflections of the instrument when the motor is stopped are simply due to the difference of potential between the brushes, depending upon the resistance of the armature coils and the proportion that resistance bears to the whole resistance of the circuit.

When the motor is allowed to run the tension meter shows an augmentation of difference of potential between the commutator brushes, the current itself, as measured by a current-meter, necessarily falling off. If there was no friction to overcome in the motor, and no heat produced by the frequent changes of polarity in the iron of the armature, the product of current into E.M.F. as indicated by the instruments would be identical, whether the motor was running or not. The augmentation of potential when the motor is running free is a sort of storing up of force ready for immediate use, and may be likened to a weight raised and kept in suspense by manual labour. A continued exertion of energy must be employed to keep it up. This is what the motor does when it runs freely; the moment it is loaded this store of energy is drawn upon, the tension-meter shows that the difference of potential is less, the current-meter shows that the current has augmented; but the product of the two is now less than before, the difference being energy converted into work.

If you should think these few remarks worthy of a place

in the ELECTRICAL REVIEW I would have it understood that my sole object is to invite discussion on a subject so interesting and of such importance, and either be confirmed in my views or converted to others in more accordance with what we are all looking for—Truth.

I am, dear Sirs,
Yours very faithfully,
119, Toriano Avenue, N.W. MORITZ IMMISCH.

[There are some points in this letter which we shall hope to touch upon in a week or so, our correspondent having apparently misunderstood Professor Thompson in regard to E and e.—EDS. ELEC. REV.]

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Having been myself engaged in teaching experimental physics during several years, I have been much interested in the correspondence which you have printed in recent numbers of your journal on the above subject, and as I recognise in the case of the City and Guilds of London Institute as presented by your correspondents, many of the difficulties which I myself experienced, and the practical removal of which was in some measure due to my own exertions, I venture to think that some account of the system successfully practised at the Massachusetts Institute of Technology in Boston, U.S.A., where as student and instructor I passed about eight years, may be of interest and assistance to those engaged in similar work here.

The system included instruction by lecture and by laboratory practice. The lectures followed a text-book (Ganot's Physics), with a copy of which each student was obliged to provide himself, but great freedom was exercised in omitting and inserting a large amount of matter which the student was required to make notes of, and which was equally a subject for examination with the matter of the text-book. The lectures were very fully illustrated by experiments, sometimes the same which the student was afterwards to perform for himself, sometimes by others of a more delicate or costly kind which could not be intrusted to his hands, and all mathematical demonstrations were fully gone through with on the blackboard, with opportunity after each step for the students to ask questions. Students were also at liberty to remain after the lecture to get further explanations from the professor on any point which they had failed to understand. The system of note-taking at lectures was found, however, to interfere very much with a close following of the lecturer, and on this account it was afterwards almost entirely superseded by a written (heletograph copy) or printed syllabus of each lecture, which was given to each student. Once in about ten or twelve lectures a brief written examination was given, occupying perhaps 15 or 20 minutes of the lecture hour, and at the end of each term (four months), there was a full written examination, covering all the term's work, on which the student's right to remain in the class depended.

The student was not allowed to enter the laboratory until the lectures had proceeded far enough to make sure that they would always keep in advance of the laboratory practice, for it is of no use to set the student to perform experiments the principles of which he does not yet understand. In the laboratory a text-book (Pickering's Physical Manipulations), which grew out of the author's experience in the same laboratory, was followed, but with many variations and additions, which it was found necessary to provide for as in the lectures by written (heletograph) explanations, copies of which were given to the students when the experiments were assigned.

Boards were hung near the door of the laboratory, on which were fixed a number of cards bearing the names of the experiments, and where duplicate apparatus was provided duplicate cards were also placed upon the boards. Under or opposite to each of these cards was a blank space with a peg or spring clip upon which was hung a card bearing the name of the student to whom the corresponding apparatus was for the time being assigned. The board thus showed at a glance what apparatus was in use and by whom, and when a student had finished his experiment it was a very simple matter to transfer his card to any other unoccupied experiment which he had not previously done. Generally the experiments were so planned as to just comfortably occupy the time of one exercise, and the assignment of new work for the next time was made and any necessary papers given to the student before leaving, so that he might read the explanation of each experiment before coming in to perform it. In the case of several classes alternating with each other in the use of the same apparatus there was either a separate set of boards for each class or several blanks for name cards were left opposite to each experiment card, and the names belonging to each class kept in a separate column. A small book was kept in which the students' names were recorded, with the names of the experiments at the tops of as many vertical columns following that containing the students' names, and it was our practice to rapidly run through the book at the beginning of each term, and make a mark opposite each student's name in each of the columns corresponding to the experiments which he was expected to perform during the term, alternating equivalent experiments and having regard to the cases where duplicate apparatus allowed of all the students having a turn at the same one. A slightly greater amount of work was thus laid out than the student could reasonably be expected to do. This plan avoided the possibility of assigning in the hurry of the class-room a number of equivalent experiments to one student to the neglect of others, equally important, and also inspired a certain confidence in the student by giving the impression that a certain amount of care had been taken to lay out his work to the best advantage. When a student's card was changed to a new experiment the mark in the book corresponding to the experiment last done was crossed by way of record. Each student was required to keep a laboratory book, in which he noted the results of his experiments, and which he took home with him for the purpose of working them up. This book, containing results and calculations, with curves plotted on cross-section paper to show the general laws deduced, or from which these laws were deduced, was handed in at the end of the term, and taken, in connection with the results of written examinations, as a basis of the student's rank and right to remain in the class.

I have been thus minute, even at the risk of claiming more space than you can spare me, because my experience was that it was easy enough to lay out a general plan for such work that was all right on paper, but the question of its practical success or failure depended upon the conscientious working out of every detail more than upon general correctness of design.

Certain general principles, however, are essential to any great degree of success; and in conclusion, I may be excused any seeming presumption if I offer a few suggestions as the result of experience both as student and teacher. It may safely be assumed that the students who enter any purely technical class mean business; they come as a preparation for earning their daily bread, and they cannot afford to waste their time. They may therefore be depended upon, if given a fair chance, to do good and faithful work, and if by chance a few get in who show an idle or mischievous disposition, it is only common justice to the rest to turn the former out. This may most easily be done by frequent examinations, at which a certain proficiency is made an absolute condition of continuance, with perhaps an opportunity to make up allowed to those who come very near to the required standard. A single student who will not do his own thinking, or cannot, will, if allowed, consume more of his teacher's time, at the expense of his fellows, and break and derange more apparatus than a dozen good students. The only way is to give each one his fair share of attention, and if that does not enable him to keep up, drop him. As long as any student is allowed to remain, however, the utmost patience and consideration must be shown him, for if this be relaxed his ambition, what little he may have, will vanish, and he might better be dropped at once, as his continuance will tend to demoralise the rest.

The most common mistake made by lecturers is to suppose that their first duty is to cover a certain ground in a certain time; better by far go over only half as much and be sure that the student is not hurried to the point of losing his interest through sheer inability to keep up; for if a student is hurried over the ground he gets but an uncertain knowledge, which proves such a discouraging foundation to build upon that he seldom gets beyond the point where his teacher leaves him, while if he is allowed time to settle each foundation-stone firmly in its place, and get in plenty of cement

between the stones as he goes on, he will have a solid bottom to stand on that will give him courage to go on for himself.

Again, do not think it a favour to a student to admit him without proper preparation; he will only spend his time to no purpose listening to what he cannot understand; and however low the standard of admission let every part of the instruction correspond to it, being sure to start each demonstration far enough back to reach firm bottom on the student's previous knowledge, otherwise the whole structure is built upon the sand.

In the laboratory let every piece of apparatus be in perfect working order, and if it is found otherwise when a student comes to it, give him another experiment and have it repaired before the next time. Again, do not make the experiment so long that the student cannot take time to do it well, as enforced haste is a sure teacher of carelessness.

Another point: it is entirely unnecessary in teaching general principles to provide the student with delicate and costly apparatus. Provide simple, cheap, rough, but fairly correct apparatus, and enough of it for all. A student will learn the use of the Wheatstone bridge, for instance, quite as well from using an ordinary set of coils or divided metre-bridge with a five-shilling galvanometer, as from the finest set of coils and a Thomson reflector. The fact that he is unable to get more than two or three significant figures will save him time in his calculations without sacrificing any principle, and when he comes at a more advanced stage to use better instruments he will appreciate them all the better from knowing the faults of the rougher ones. Moreover, knowing that much can be done with comparatively rough instruments, he will not, in his future practice, make the too-common mistake of wasting time and money by using delicate instruments and calculations to a dozen decimal places on coarse work where very likely the nearest integer is necessarily uncertain.

Last, but not least, no laboratory instructor should have more than ten, or at most twelve, students to look after at one time; if he has it will not be fair to criticise his patience and efficiency, or want of them, too sharply; and he cannot do justice even to ten unless they are well provided with written or printed explanations, sufficient for an average understanding to follow with only an occasional lift.

In closing I wish to apologise for claiming so much of your space, and also to disclaim any intention of presuming to dictate to those who perhaps have had more experience than myself, or of aiming my remarks entirely at any particular school. Indeed, I trust that my remarks may serve quite as good a purpose in indicating to students and others what they can fairly expect of a teacher, as in helping teachers by giving them the benefit of my small experience. Much of what I have written may be quite superfluous to the experienced teachers of the City and Guilds of London Institute, whose particular case I have cited, but I doubt not there are many other classes of a similar kind about starting to whom a word in time may be of great use.

Believe me, Gentlemen,
Respectfully yours,
J. B. HENCK, Jun.

31, Queen Victoria Street, London, E.C.

THE TELEPHONE PATENTS AND COUNSEL'S OPINION *v.* JUDICIAL DECISIONS.

To the Editors of The Electrical Review.

Sirs,—I herewith send to you the sequel to the correspondence published in your excellent Review of 16th inst. The letter dated 29th November, addressed to Messrs. Gent & Co., by Messrs. Waterhouse & Winterbottom, looks very much like a wilful disobedience of the injunction granted by Mr. Justice Fry on July 22nd last, against the United Telephone Company, forbidding that company from stating that "no form of magneto telephone, and no form of transmitter in which carbon or any equivalent substance is employed."

Extract from a letter addressed to Messrs. J. T. Gent & Co. by Messrs. Waterhouse and Winterbottom, Solicitors of the United Telephone Company:—

London, 9*th December*, 1882.

Gentlemen,—We have carefully examined the instruments which you sent us, and have consulted Mr. Moulton, our counsel, on the subject. He agrees with us that both transmitter and receiver are infringements of our clients' patent rights.

Leicester, *December* 16*th*, 1882.

Gentlemen,—Your letter of 9th inst.; addressed to Messrs. J. T. Gent & Co., of this place, has been handed to me. I take leave to reply to that part of your letter which refers to the excellent Lockwood-Bartlett receiver, and to the transmitter of Messrs. J. T. Gent & Co.

It seems that my letter of 2nd inst. addressed to you has led you to seek counsel's opinion to corroborate your own extraordinary opinion, given in total ignorance of the subject-matter.

The selection of Mr. Moulton is a very unfortunate one for your clients; and it is beyond comprehension that you should be so ignorant of your clients' patent rights, after the crucial examinations of them in the case of the United Telephone Company *v.* Harrison Cox-Walker & Co., in which case Sir William Thomson, "the most eminent electrician in the world," and other electricians—all your witnesses—so accurately described your clients' patents, added to which you have the lucid and precise description of your clients instruments and claims by Mr. Justice Fry.

Is it possible that you prefer opinions to judicial decrees ! ! !

You referred Messrs. Gent & Co. to the judgment rendered by Mr. Justice Fry, and to that by Lord M'Laren, and when you were informed that those judgments were adverse to the preposterous claims of your clients, you sought to intimidate Messrs. Gent & Co., and to prevent them from prosecuting their legitimate business by sending to them opinion of counsel, and writing about "the very heavy expenses which a litigation would involve."

The opinion of Mr. Moulton, however high he may rank as a learned barrister, or whatever reputation he may have as an *amateur* electrician, certainly is not entitled to the weight which a solemn judgment by a judge in Chancery carries with it.

Even if there were no judgment by a judge in Chancery directly at variance with the opinion of Mr. Moulton, I have a reason—and a good one too—for questioning the rightfulness of his opinion in this matter, as I have two opposite opinions given by this eminent barrister on the question of infringement of the Edison patent for a transmitter, which is the *only* valid patent for transmitters owned by your clients. I am aware that your clients purchased for a large sum Crossley's patent for a transmitter, *after* they had published to the world that the Crossley transmitter was an infringement of Edison's patent. Mr. Crossley's patent, however, according to the following opinion, seems to be invalid.

We are of opinion that the variance between the provisional and complete specification of Crossley's patent is so great that they substantially refer to two totally distinct inventions or alleged inventions, and that this would be held to be fatal to the validity of the patent, independently of any question of its novelty.

(Signed) HENRY JAMES (Attorney-General).
FARRAR HERSCHELL (Solicitor-General).
J. FLETCHER MOULTON.

March 21*st*, 1881.

I take leave to cite another opinion:—

We are of opinion that the Gower-Bell telephone transmitter is not an infringement of Edison's patent of 1877, as amended by the proposed disclaimer.

(Signed) HENRY JAMES (Attorney-General).
FARRAR HERSCHELL (Solicitor-General).
J. FLETCHER MOULTON.

March 21*st*, 1881.

The Gower-Bell transmitter has "the combination of a vibrating diaphragm and a tension-regulator," and Mr. Justice Fry, in his judgment above referred to, said, "I have concluded that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension-regulator."

This judgment was rendered in May, 1882, subsequent to the above opinion of counsel, and until that judgment be reversed by a higher tribunal it must stand as the law of the land.

Now, the same Mr. Moulton gives his opinion that a transmitter, that of Gent & Co., which has no diaphragm nor the semblance of one, is an infringement of Edison's patent, an "essential requisite" in which is a diaphragm.

With such contradictory opinions emanating from the same eminent barrister, especially when both of those opinions are directly contrary to the judgment rendered by a judge in Chancery, I do not think I am discourteous in saying that the opinion given by Mr. Moulton in this case has no weight with me, nor do I believe it can have any weight with any person.

"Tempora mutantur, et nos mutamur cum illis," may account for the discrepancy of these two opinions of this eminent barrister, for in 1881 he was counsel for the oppo-

nents of the United Telephone Company, and gave an opinion that a transmitter having "a diaphragm in combination with a tension-regulator" was *not* an infringement of Edison's patent; and now in 1882 he gives an opinion that a transmitter without a diaphragm *is* an infringement of Edison's patent, both of these opinions being at variance with the judgment of Mr. Justice Fry.

Although I make no profession to any knowledge of the practice in the Court of Chancery, it seems to me that the United Telephone Company, by their threat of prosecuting for infringement the manufacturers of instruments clearly free from infringement, according to a solemn judgment of a judge in Chancery, are guilty of a "contempt of Court." To the United Telephone Company I will merely say, "Quem Deus vult perdire priusquam dementat."

Yours truly,

W. C. BARNEY.

To the Solicitors for United Telephone Company,
1, New Court, Carey Street, Lincoln's Inn.

ANSWERS TO CORRESPONDENTS.—"A Subscriber's" letter arrived too late for insertion; he will, however, find that which he requires in our other columns.—EDS. ELEC. REV.]

NOTES.

ELECTRIC LIGHTING.—Mr. Groth, the representative in London of the Jürgensen dynamo-electric machine, writes to us conveying the information that this apparatus has recently been experimentally compared with the well-known Gramme machine in Denmark. The following is the text of Mr. Groth's communication:—

Extensive trials for the purpose of comparing the merits of the Gramme and the Jürgensen dynamo machines were recently made at Copenhagen by the Danish Government, who had appointed a special committee consisting principally of officers in the Royal Danish Artillery and engineering corps.

Two machines were ordered at the same time and on the same conditions, one from Gramme, ordered of Messrs. Sautter Lemonier & Co., Paris, and one from Mr. Jürgensen for 4,000 bec carcels each.

For driving each of the dynamos a 14-horse-power Brotherhood engine was used, and in each case the connections between the machines and the engines were exactly the same. The steam pressure was 60 lbs.

The following table will show the average of the four days' working.

	Gramme.	Jürgensen.
Revolutions per minute	475	400
Normal light	28,890	40,000
Temperature between the ring after 4 hours	30°R.	25°R.
Resistance in the dynamo in ohms... ...	0·424	0·390
Length of wire on the magnets in metres...	3,160	330

From this it will be seen that the Jürgensen dynamo gave 38 per cent. more light than the Gramme, while at the same time the Gramme dynamo required 3,160 metres on the two magnets, against the 330 used by the Jürgensen, which is a difference of about 90 per cent. in favour of the Jürgensen.

APROPOS of the running of the Edison machines during the recent foggy weather we notice letters in the *Times* of the 16th inst., on behalf of the South Eastern "Brush," and the Maxim-Weston Electric Light Companies respectively.

Mr. Offor, the Manager of the former company, says that the offices of the company and those of the Provincial "Brush" were lighted from storage batteries throughout the foggy weather without the use of a dynamo at all, except during the period of charging the cells, the lights burning with that perfect steadiness which is so important a feature in the storage system.

For the Maxim-Weston Company, Admiral Inglefield the Chairman, wrote as follows:—

"The Maxim-Weston Electric Company light Southwark-bridge, Queen-street and place, and Queen Victoria-street with 32 Weston arc lights, each giving a light equivalent to 1,400 candles. During the period alluded to in the letter under notice—namely, from Saturday afternoon till Tuesday morning, these lights were run most satisfactorily, and this without having recourse to the spare engine or dynamos, which are always ready in case of accidents.

"Pentonville-road is lit at present for 16 hours daily with 82 Maxim incandescent lamps, used in the ordinary gas lamps, which could have been also run as above, without the least difficulty, if the vestry had desired it."

AT a meeting of the Wandsworth Board of Works, the Battersea Committee recommended "That sanction be given for the full development of electric lighting operations, provided the promoters prove their ability and efficiency for the due execution of the necessary works, and that conditions are secured for protecting public and private rights before assenting to a licence or provisional order."

The recommendation was adopted.

THE Newington Vestry has received a letter from the promoters of the late indignation meeting, to which we referred in our last issue, asking the vestry to consider the opinion of the ratepayers and comply with their request by rescinding the resolution passed on November 1, or pass a fresh one whereby no further steps should be taken for the present in applying for powers to adopt the Electric Lighting Act, or take some other course of action to abandon the scheme. They begged the vestry to give the matter their serious consideration.

IN the Lambeth Vestry the surveyor reported that the Brush Electric Light Company, without applying for any consent from the vestry, had erected a cable across the Brixton and Atlantic roads. The clerk had written to the company, requiring the immediate removal of the cables, and a letter had been received from the manager of the company, regretting that the cables had been erected without the formal consent having been applied for, and that the company were prepared to abandon the present plan as soon as the company could complete arrangements for running cables below the surface. Should the company not remove the cables, the Electric Lighting Act gave the vestry full power to have the cables removed, and the committee instructed the officers of the vestry to enforce the Act if necessary.

This course was adopted, not in opposition to the electric lighting companies, but in order to assert the rights of the vestry as the road authority.

A PETITION recently presented for the winding-up of the Brush Midland Electric Light and Power Company (Limited) has been withdrawn, the company paying costs.

THE Edison electric light seems likely to meet with success in Australia, where it is being introduced under the auspices of Major Flood Page, the late manager of the Sydenham Crystal Palace. The aptitude of the gallant major for his post is very *naïvely* put by the *Melbourne Herald*, of November 7th, in the following terms:—

The Edison Electric Light Company did a very wise thing when they engaged Major Flood Page as their general manager, for that gentleman undoubtedly understands exactly how to place the plans of the company before the public in an expeditious and effective manner. Last night he gave a dinner-party to about fifty gentlemen in the Café Gunsler, &c., &c.

During the evening the town clerk expressed himself to the effect that he hoped before twelve months had passed the streets of Melbourne would be illuminated by means of electricity.

Major Flood Page gave a description of what had been accomplished in England and America by the Edison system.

WE also notice that the offices of the *Sydney Morning Herald* have been fitted up with Edison lamps under the direction of Mr. H. H. Kingsbury, the representative of Mr. Edison in New South Wales.

THE Pullman train to Brighton is now fitted with 40, instead of 18, incandescent lamps, owing to the employment of the new Faure-Sellon-Volckmar accumulator supplied by the Electrical Power Storage Company. This company, by virtue of arrangements referred to in another column, has now the sole right in England for these storage batteries. In the first instance 70 Faure accumulators (original pattern) were required for the 18 lamps, whereas there are

now only 30 Faure-Sellon-Volckmar cells supplying 40 lights, their total weight being considerably less than halt those formerly employed.

"IT'S an ill wind that blaws naebody good," was doubtless the thought of Mr. Akester the other afternoon, as the Glasgow merchant hurried into his office and asked an immediate installation of the electric light, as his gas supply was completely stopped by the severe frost. The request was complied with, and by 5 p.m. the shop was brilliantly lighted up. The occurrence has already brought business and is expected to lead to more shortly.

AN action was raised before Lord Adam, in the Court of Session, Edinburgh, on Wednesday last, by James Wylie Guild, C.A., Glasgow, against William Plenderleith Hope, merchant, Leith, and the Scottish Brush Electric Light and Power Company. Pursuer was engaged to get up a new company, and had proceeded a certain length when the defenders took the matter out of his hands, and gave it to Messrs. Panmure, Garden, & Co., London; and he now sues defenders for alleged breach of contract proportionate to the work done before it was taken out of his hands. Intimation of the action was ordered to be made to Mr. Molleson, the liquidator of the Electric Company, which is now in liquidation.

THE Local Boards of Withington, Moss Side, Rusholme, and Stretford have conferred together and decided not to proceed with their applications for Provisional Orders, considering the experimental stage of electric lighting.

ABOUT a month ago the Sheffield Town Council decided to apply for a Provisional Order. This decision was, however, only arrived at by the casting vote of the Mayor. The order has been prepared, and a retainer given to the town clerk to take such proceedings as may be necessary for obtaining the requisite authority from the Board of Trade and certain expenses incurred. At the Town Council meeting last week the subject of electric lighting was once more brought forward. An attempt to prevent payment of the expenses was defeated by a majority of one, but on the minutes of the committee being submitted for confirmation they were rejected by a majority of one. The Mayor, who entertains a very strong feeling in favour of the town having the electric light in its own hands, expressed his willingness to find the expenses out of his own pocket. On Monday last the committee agreed to proceed with the application for a Provisional Order for lighting the centre of the town.

THE CATALOGUE OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—On glancing over the catalogue of additions to the library of the Society of Telegraph Engineers, appended to the report of the librarian, we notice, under the pseudonym of "Christopher Caustic, M.D., LL.D., A.S.S.," a work treating on electrical quackery, or, as the author terms it, "Galvanising Trumpery," published in 1803. If there was occasion for writing on this subject eighty years ago, how much more could be written at the present time, when the Patent Office is crowded with so-called inventions of a more or less ridiculous character. We are glad to see that the library of the society is being enriched and completed by the addition of the older works on the subject, as well as the more modern ones.

NEW COMPANY REGISTERED.

GENERAL ELECTRIC LIGHT AND POWER COMPANY OF RUSSIA (LIMITED).—Capital £500,000, in £1 shares. Objects: To carry into effect an agreement between Alexis Joseph Rousseau and the Swan United Electric Light Company, Limited. Signatories (with one share each): R. E. Crompton (electric light engineer), Mansion House Buildings; G. W. Batt, 20, Great Winchester Street; G. F. Rogers (telegraph engineer), 5, Great Winchester Street; H. T. Nell, 29, Oakfield Road, Clapton; A. J. Rousseau (telegraph engineer), St. Petersburg; E. Fox, Milwall; S. Gray, 4, Bramerton Street, Chelsea; P. Belloc, Forest Gate, E. The signatories are to appoint the first directors. Qualification: 250 A shares. Registered 18th inst., by Ashurst, Morris, and Crisp, 6, Old Jewry.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

ORIENTAL TELEPHONE COMPANY (LIMITED).—The return of this company, made up to 3rd of May, was filed 8th of May. The nominal capital is £300,000, in £1 shares. The number of shares taken is 274,580. The full amount has been called upon the 75,000 vendors shares, and 10s. upon the ordinary shares. The calls paid amount to £174,842 10s. leaving £157 10s. unpaid. £100 has also been paid upon 800 shares forfeited. Registered office, 3, Great Winchester Street, E.C.

* LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY (LIMITED).—The return of this company, made up to 2nd of June, was filed on 17th of June. The nominal capital is £600,000, in £10 shares. The only shares *recorded* as taken up are 7, and these are considered to be fully paid. Registered office, 31, Queen Victoria Street.

PHŒNIX MEMNON (LIMITED).—The return of this company, made up to 1st of September, was filed on 13th of September. The nominal capital is £1,600, in £8 shares, the whole of which have been taken up. £4 per share has been called, the calls paid amounting to £272 and unpaid to £528. Registered office, Baker's Lane, Buckden, Huntingdon.

* The company proceeded to allotment after the filing of this return.

CITY NOTES, REPORTS, MEETINGS, &c.

THE FAURE ELECTRIC ACCUMULATOR COMPANY, LIMITED.

AN extraordinary general meeting of the shareholders of the Faure Electric Accumulator Company, Limited, was held at the Cannon Street Hotel, on Monday last, under the presidency of Sir A. J. Otway, M.P., chairman of the company, for the purpose of ratifying, or otherwise, the following agreements which had been provisionally entered into:—1st, An agreement between the Faure Electric Accumulator Company, Limited, of the one part, and the Electrical Power Storage Company, Limited, of the other part, for the sale by the Faure Company to the said Storage Company of the remaining interest of the Faure Company in the patents of Faure, Sellon, and Volckmar in England, on the terms and conditions mentioned in the said agreement. 2nd, An agreement between the Société la Force et la Lumière, of the one part, and the Faure Electric Accumulator Company, Limited, of the other part, for the purchase by the Faure Company of the rights and interests of the Société la Force et la Lumière in the French Electrical Power Storage Company, Limited, on the terms contained in the said agreement. 3rd, An agreement between the Faure Electric Accumulator Company, Limited, of the one part, and the French Electrical Power Storage Company, Limited, of the other part, for the sale by the Faure Company to the said French company of the property in Paris belonging to the Faure Company, and providing for the Faure Company subscribing for shares in the said French company, as provided in the said agreement.

Mr. Herbert Canning, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have heard the notice read convening the meeting, which, I need scarcely say, is one of considerable importance to all of you who are interested in the Faure Company. Now, certain contracts have been provisionally signed by the board of the Faure Company. I say provisionally, because these contracts have no validity whatever until you should ratify and approve of them. These contracts have been drawn in pursuance of the policy indicated to you on previous occasions by M. Phillipart: on which two occasions you unanimously gave your adhesion. On the second occasion I felt bound to tell you that the board, not concurring in the mode of procedure, would be unable to continue their functions as administrators of the company, and that they would ask to be relieved from the office which they now hold, and that others should be appointed in their place, and I expressed the opinion that those to fill their places should be those who were in entire accord with M. Phillipart in the policy he was about to carry out; and as the work of the company would henceforth be carried out in France, I thought it right that they should be French and not English directors. M. Phillipart accordingly entered into certain arrangements with which I had no concern, which he has, I think, explained in a clear manner to you. Certain arrangements were made which were limited as to time, had been made by M. Phillipart, and the consequence was that the board, unless their arrangements were to fall through entirely, and the prospects which appeared to M. Phillipart were to be dispelled it was necessary that the agreements should be provisionally signed by the board. Hence, Gentlemen, that which may appear an inconsistency, but which is really not so in point of fact, is perhaps to be found on the part of some of you who hear me, that the signature of some members of the board is given to contracts which they themselves do not approve. It was because time was the essence of this matter, and under the conditions that they should be entirely a provisional character. Now, I am not here to express an opinion on the contracts themselves; they will be read by our solicitor, and M. Phillipart will address you thereon. Nor am I about to enlarge upon the feelings of the board with regard to them. A mode of carrying on a business commends itself often to one

person, but is not so favourably spoken of by another. One condition, Gentlemen, I think it essential to make. I adverted to it on the last occasion. It is necessary that I should mention it. I said I would not leave my place at the board until I was certain that that which I considered a sort of honourable engagement which had taken place towards certain shareholders had been fulfilled, or until the means were provided by the day named. I allude to the supplying of every shareholder who has applied for the same, one fully paid-up share with regard to 2 shares he holds with £2 paid thereon. It has not been possible to divide these shares at the present moment so as to give to every shareholder his one share fully paid-up for the two which he resigns; but a certificate for the aggregate amount necessary to do that will be lodged with myself and our solicitor for the carrying out of this operation. I understand that at latest on the 2nd January next M. Phillipart will be prepared with all the certificates divisible amongst the shareholders who applied for them I also understand that a letter will be sent to all the shareholders with regard to that matter. Well, when that is done, I can say I shall consider our business as administrators of this company terminates. We have endeavoured to do our best; we have had as little agreeable a time and as anxious a time as it is possible for any body of gentlemen to have. It is always difficult for gentlemen who have conducted business on certain lines suddenly to be called upon to conduct that business on other lines. We have endeavoured to popularise the accumulator and make it known in this city. My own hopes are that it will be a success, and I am sorry, perhaps, that it will not be in England that its great success will be attained; but there are conditions in France, concerning the price of gas and the cost of coal, which will make it a more profitable concern in France than in England. We wanted to form an industrial company, that was our sole wish; but as the business is now transferred to another country, our usefulness ceases. And we now seek the earliest moment at which we can to retire from the place of confidence in which you have placed us. I think that cannot take place at once; there are some necessary proceedings. M. Phillipart will remain, and it will be necessary to nominate one other, and these, forming a quorum, will be able to find some satisfactory colleagues to carry on the business of the company. I shall be glad if any gentleman present will interrogate us on any matter on which he may wish to have information. We have nothing whatever to conceal, and therefore we should like to have this opportunity of answering any gentleman's questions concerning the company, or the way in which it has been carried on, or any remarks which he has to make.

M. Phillipart said: The contracts which were to be that day submitted for the approval of the shareholders, were only provisionally signed on Thursday last. He thought they really ought, and might have been signed sooner and without the reservation of their approval, for they only carried out the programme which the shareholders unanimously approved on the 6th November last, and the particulars of which the shareholders received with enthusiasm at their last meeting on the fourth of this month. He could not now enter into all the details of those contracts, for it would take up too much time, and would, besides, be unwise in their common interests. But I wish again to touch upon the salient points, in order that you may seize the advantages we shall derive therefrom. By those contracts the Storage Company returned to the Faure Company their 20,000 fully paid-up ordinary shares, which were sold to them by the agreements of the 6th and 7th July last; and the Société la Force et la Lumière surrenders as well 50,000 deferred shares. On the other hand the Faure ceded to the Storage Company, definitely and entirely, the interest it retained in the Sellon and Volckmar patents for the United Kingdom. By the second and third contracts the Faure Company obtained possession of about 92 per cent. of the Faure, Sellon, and Volckmar patents for France and the French colonies. In virtue of these contracts that interest would be represented by preference and ordinary shares of the French Electric Power Storage Company; which company possessed the exclusive right for the exportation of those batteries. The intention of the French company was to sell some of those shares and to employ the proceeds of such sales in the purchase of Faure, Sellon, and Volckmar patents for other portions of the continent, reserving the balance either to distribute to the shareholders, in whole or in part, as dividends, or to be retained by the French company, as might be most advantageous to them. After the fulfilment of those contracts, and with the 40,000 shares of the French company fully paid up, the following would be their financial position:—Of the 80,000 ordinary shares in their company, 47,000 only would be issued, leaving 33,000 unissued. Their assets would consist of an interest representing about 92 per cent. of the Faure, Sellon, and Volckmar patents for France and the French colonies, and they would further have available a sum exceeding £100,000. He trusted that the shareholders would be pleased with that. After the execution of those contracts, the French company expected to be able to pay, in the course of the month of January, a dividend at the rate of 10 per cent. per annum from the date of issue upon the £2 paid on their 40,000 ordinary shares. He might add that he had cogent reasons for stating that during the month of February next the French company would be able to declare a further dividend of at least £4 per share, and he hoped for still greater things. It was, of course, understood that the execution of those contracts assured the fulfilment on the due day of the engagement taken by the "Société la Force et la Lumière," with those among the shareholders of the Faure who had accepted its offer. Their chairman and his colleagues deemed it right to retain their seats until this engagement was fulfilled. He did not wish to under-rate the value of the work of his colleagues, but he wished to take this opportunity of stating that the "Société la Force et la Lumière" never had any idea of departing from its undertaking. On the contrary, it was pleased that so many of the Faure Company's shareholders had accepted its proposal; that it was of opinion that it had done good business, which it would not relinquish on any account. The interests of the shareholders who transferred their shares would be as well looked after by the French company as by others. Certainly they were not infallible, and might make mistakes, but if that were the case the shareholders had the satisfaction of knowing that they themselves would be the greatest sufferers. Perhaps he might be allowed to once again touch upon the value of the invention the company possessed, and to enter into a few details in connection therewith. On the 6th November last he told them that the accumulator was as great a necessity for electricity as was the gasometer for gas. Secondly, that the Faure, Sellon, and Volckmar accumulator, was so far the only practical and economical accumulator. Thirdly, that they had the best reasons for believing that it would not be superseded. He did not believe that any one would even now attempt to controvert the two first assertions, and in support thereof he was pleased to be able to tell them that the company which had purchased the Donnithorne accumulator, of which they had heard so much, had entirely abandoned it and had applied to the Storage Company to furnish it with all the accumulators it requires. Indeed the Storage Company cannot nearly execute all the orders it receives, although producing 250 tons of accumulators monthly. As to the third, it would be said that no one could put a stop to the progress of science. The question to be solved was the extent of progress which was required to attain perfection; and consequently the sooner they attained to perfection the less room would there be for improvements, and therefore the less they would have to fear. To arrive at the relative value of the invention three things had to be considered. First, prime cost; second, cost of maintenance; thirdly, yield. Now, what progress still remained to be made under these heads? Prime cost. Their accumulators were now made exclusively of plates of lead, cast with holes in them, into which holes was put red lead or oxide of lead. These plates, after having been formed by the passage of electric current lasting 100 or more hours, were placed in a wooden box, lined with sheet-lead, and separated from each other by india-rubber bands. The first cost of the material was £15 or £16 a ton, and that of the labour about an equal amount. What could be discovered simpler and more economical? Maintenance. Half the plates composing the accumulator are called positive and half negative. Experience proves that the negative plates did not wear out in working. The positive plates only after a greater or less number of months' work become unapt for work, owing to the entire peroxidation of the plate. Thus the maintenance of the batteries renders replacing of one half of the plates necessary every year as a most liberal estimate. But this replacing simply implied a question of labour, seeing that it was only necessary to grind up these peroxidised plates, and with this ground peroxide to fill up the holes in the new lead plates, unless indeed, which was probable, this peroxide was sold at a much higher price than the lead or red lead, in which case the maintenance of accumulators would become a source of profit instead of a source of loss. It was clear, therefore, that both from the point of view of cost of maintenance, and from the point of view of prime cost there was little room for improvement. Yield. Eighteen months ago Sir William Thomson had certified for the first Faure batteries which were subjected to experiment by him had given a yield exceeding 75 per cent. Six months later their eminent electrical engineers, Messrs. Perry and Ayrton, had certified a yield of over 80 per cent., and he was satisfied that to-day, with a good system of charging and discharging, they could obtain a yield exceeding 85 per cent. Such being the case, was he not justified in telling them that they need not fear more from the future than from the past, and that the progress they had made during the last twelve months was a guarantee of that which they should continue to make? Further he did not lose sight of the fact that any improvements made by others would belong to them and would remain useless in the hands of the inventor so long as their patents were in force. They saw, therefore, on what a solid basis their confidence in the future of the company was founded. In conclusion he wished to say to them that they had given up all idea of liquidating the company, as they had found that there would be considerable legal difficulties to be encountered and overcome, and moreover, after mature consideration, they were of opinion that their company, which was the first in the field, could maintain its position and organise and direct others.

Professor Ayrton, in speaking on the mechanical construction of the accumulators of the present time, said that the Faure accumulator of to-day was enormously in advance of what Planté had done before. The accumulator originally suffered from three defects. An accumulator was like a cellar of coals with a small door: it would contain only a certain amount of coal, which they could get out but slowly. What they had been doing lately at Millwall and at Paris was to try and make the cellar hold much more coal for the size, and give it out more quickly. During the last year great strides had been made in this respect, and the accumulators now submitted were twice as good as those which were submitted a year ago, and would give out twice as quickly—which was a very important point. It did not so much matter when the thing was stationary, but when they came to the locomotion or propelling of tramcars, tricycles, and so on, then the giving out of electrical energy very, very quickly was of the utmost importance. Only quite recently they were in the habit of having very heavy "horses," and yet they would only go slowly. They had now light "horses," which proceeded swiftly, but who require filling frequently. They had propelled a tricycle by means of a Sellon accumulator a mile in 8½ minutes. Then with regard to propelling boats, they had also made great strides during the past 12 months, as they would now give out quickly without polarisation. He went a journey a few weeks ago in the electric boat, and he went again on Saturday last, and the result then was quite as satisfactory as before. They travelled at the rate of seven knots against the tide, and 10 or 11 with it. He had tested an accumulator which weighed 130 lbs., which gave a horse-power for three quarters of an hour. And he had tested one on Saturday which weighed altogether 75 lbs., but which gave out a horse-power for one hour. Thus, with only half the weight, they got as much storage capacity;

therefore the cells must have contained twice as much energy with the same dead weight, and which were able to give out the electric energy quickly, which was of immense importance. The accumulators of the present day were, looked at from an electrical point of view, twice as good as they were a year ago. Moreover, the cells were so constructed now that they could take the plates away and put a new plate in its place.

In answer to a question, Professor Ayrton said that an electrically driven tricycle differed in the eye of the law from one driven by steam, which latter was virtually a "locomotive."

Mr. D. Thomas said: When they met at the first meeting to inaugurate the new policy the tone of the chairman's speech was eminently in favour of the new policy being adopted, and that influenced the meeting much. He should like to know whether anything had occurred to cause him to alter his opinion.

The Chairman thought that a very proper question. He had no desire to say anything unfavourable to the policy of M. Phillipart. He had spoken of his scheme in general terms, but where he had been unable to agree with him was as to the procedure by which he had carried out that policy. He (the chairman) had never been mixed up with any financial matters. He had great confidence in M. Phillipart as a business man, and he thought these matters in France would be of benefit to the shareholders.

Sir Charles Clifford (deputy chairman of the company) said the present board took the position they did believing they were going to carry out one of the most wonderful productions of the present day, and that they were going to develop an accumulator which they thought was in their own hands, and was likely to be productive of wonderful events in the world. The board determined to do their best to forward the interest of the shareholders and the interest of the world at large; for he thought the interests of the accumulator was very much wrapped up in the interests of the world. That state of things went on for a time, when the board found that two-thirds of the shares had got into the hands of one person and his particular friends. The possession thus obtained over the company would naturally prevent the board from carrying out their schemes and intentions, if they so happened to differ from him and his friends. And moreover, when those interests were to be identified with French and not English interests, and moreover those schemes were not intended so much for the development by the board itself of the wonderful powers of the accumulator, as for the working of the accumulator financially, whereby he would gain probably a greater dividend by the shareholders leaving others to the development of the principle. The board came to the unanimous determination that, though they were willing to work for the benefit of the shareholders, and for the benefit of science, they were not willing to work for the interests of a small party. They thought they should resign in favour of those who knew more about the schemes likely to be introduced than they did themselves. He had no doubt that M. Phillipart was able to carry out the interests of the shareholders. He thought M. Phillipart was right in acting as he had, believing that the interests of the shareholders would be secured by the schemes he proposed to adopt. The board had now resigned the trust that the shareholders had reposed in them entirely into the hands of others over whom they would have no control. The shareholders had heard from M. Phillipart the pleasant prospects before them; he hoped those prospects would be realised, but if that were not realised he begged shareholders not to reflect upon the late directors, but to lay all the blame or praise, as the case might be, upon the directors who were coming to them. Let the present board, he asked, go away with a clean sheet, so far as their relations with the shareholders were concerned, and he was satisfied.

A Shareholder asked whether in the event of these hopes being realised and those large dividends spoken of being paid, those gentlemen who did not consent to the transfer or the conversion of their shares would be allowed to participate.

The Chairman: Certainly.

M. Phillipart asked to say a few words in reply to Sir Charles Clifford's observations. It was entirely a mistake, he said, to think the French company were going to enter into this as a question of finance, if by finance they meant speculation. From the report which had been read to them, and the explanations of Professor Ayrton, their profits would come from the use and development of the accumulator and not from speculation. He wished the shareholders to understand that it was their simple intention to proceed in this matter as an industrial scheme, and only as an industrial scheme.

Mr. D. Thomas said he thought he understood when first the matter came before them, that this was to cease to be an industrial concern and to be worked as a financial scheme for bringing out of other companies.

M. Phillipart said in speaking of other companies, he spoke to a great extent of France and its size, and that this company would be shareholders in the company which owned the right to manufacture the accumulators for France, and to supply France they would want companies formed in large towns, who would take licences from this company, and carry on the use of electricity in towns and provide accumulators as they may be required.

Mr. Auckland asked whether the whole of the companies with which they would be associated would be limited companies.

The Solicitor replied that they would be limited companies formed under English law, of which this company received an interest of 92 per cent.

A Shareholder asked whether it was true that there was a litigation going on against the directors of this company.

The Chairman said he was certainly threatened with proceedings. The fact was that some people said we had made an agreement with them which we did not carry out. The board ordered some accumulators, but did not care to take them, some question arising as to whether they were good. However, they would be taken now, and the price would be paid according to the contract price agreed upon.

A Shareholder remarked that on the last occasion they were told the scheme was an extension of the Faure Company into France. He asked if that was so?

The Solicitor replied in the affirmative; but said that at the same time the shareholders were told that they would take their profits from a company working in France.

Mr. D. Thomas inquired whether the Faure Company's directors would hold their meetings in France.

The Solicitor said no. The directors would meet in England as hitherto.

Mr. Custance then proposed the ratification of the agreements, and that the directors be authorised by this meeting to complete and carry the same into effect, which was seconded by Mr. Albert Golding.

The Chairman having put the resolution, which was carried unanimously, said he would say no more than that the entire responsibility of that act rested entirely with the meeting. He hoped the new scheme would be thoroughly successful. Having ratified those agreements the contracts now became valid. Sir Charles Clifford had pointed out that the present board were not responsible for any of the statements that came from other parties and not from the present board, let that be clearly understood.

Mr. D. Thomas asked who would be the gentlemen to form the new board?

The Chairman said that M. Phillipart remained; that they had one vacancy on the board, according to the articles of association, and that they proposed to nominate a French gentleman, of whom satisfactory references could be given. He and M. Phillipart would form a quorum, and thus be able to form a board.

M. Phillipart said in the month of February next the shareholders would be called together to approve the nomination of the directors, who would be chosen to form a board.

The Chairman, in answer to a question, said that he had no intention to part with his interest in the company; he originally purchased 100 shares in this company; he had exchanged them for 50 fully paid-up shares.

Sir Charles Clifford said all the directors had done the same thing.

Mr. Staples proposed a vote of thanks to the board of directors and to the chairman. The board had most arduous duties to perform, and had at all times been anxious to do what was best for the proprietors. He thought they deserved great credit for having steered through the shoals and quicksands which arose from time to time. And the least the shareholders could do, was to give them a very hearty vote of thanks for what they had done. At the same time, if he might be allowed to couple the name of M. Phillipart with his proposal, he should be glad to do so. He felt that they were all much indebted to M. Phillipart, much indebted indeed to him, for opening to them so large and apparently profitable a future.

Mr. Turner seconded the proposition, which was then put to the meeting and carried unanimously.

The Chairman thanked the shareholders very sincely for the vote of thanks. It was not more than true to say that they had been in most difficult positions, having to reconcile a very great conflict of ideas. Every one of them had tried to do what he considered best in the interests of the company. Of course M. Phillipart, being the largest proprietor, said no one else had so great an interest in the company as himself, and therefore what advice he gave must be for his own interest.

M. Phillipart, in responding, said that the only way in which he could thank them was to earn for them the dividend he had promised.

The proceedings then terminated.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA.—An interim dividend has been declared for quarter ending 30th September, of 2s. 6d. per share, payable on the 16th January. The coupon on the 5 per cent. Australian Government Subsidy Debentures, due 1st January, will be paid on that date at Messrs. Barclay & Co.'s.

EASTERN TELEGRAPH.—A dividend of 3s. per share on the preference shares, less income-tax, for the quarter ending 31st December, 1882, will be paid on the 15th January, 1883; and an interim dividend of 2s. 6d. per share for the quarter ended 30th September, with a bonus of 1s. per share for the half-year on the ordinary shares (both free of income-tax), will be paid on the same date, equal (with the previous interim dividend of 2s. 6d. per share) to a distribution for the six months at the rate of 6 per cent. per annum.

GREAT NORTHERN TELEGRAPH.—A half-yearly interim dividend has been declared at the rate of 5 per cent. per annum, payable on the 1st January, 1883, by Messrs. C. I. Hambro & Son, 72, Old Broad Street, E.C.

SWAN UNITED ELECTRIC LIGHT COMPANY (LIMITED).—This company has made a call of 10s. per share, payable on the 9th of January, 1883. This call is made in order to carry out some important new installations now in hand. The call letters were posted this evening.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—The secretary informs us that the coupons due on December 31st next on this company's debentures, will be paid on the 30th inst. on presentation at the bank, by Messrs. Barclay, Bevan, and Co. Coupons must be left three clear days for examination.

TRAFFIC RECEIPTS.

The Great Northern Telegraph Company. The traffic receipts in November, 1882, were £20,440; from January 1st to November 30th, 1882, £233,730, and in the corresponding months of 1881, £218,291; and in 1880, £201,922.

The Western and Brazilian Telegraph Company. The traffic receipts for the week ending December 1st, 1882, were £2,302; for the week ending December 8th, £2,524, and for the week ending December 15th, 1882, to £2,731 after deducting the "fifth" of the gross receipts payable to the London, Platino-Brazilian Telegraph Company (Limited).

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended December 15th are £2,832, as compared with £2,476 in the corresponding period of 1881. The September receipts, estimated at £3,376, realised £3,479.

THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XI.—No. 266.

TO OUR READERS.

It is now rather more than ten years since this Journal was first published, it having commenced its existence, as, doubtless, many of our friends and supporters will remember, on November the fifteenth of the year 1872.

How interesting, mentally to glance over the intervening years and to note the changes which have in the electrical, perhaps more rapidly than in any other, branch of science, gradually, and for the most part silently, taken place!

Silently? Yes; in the main, excepting for those brilliant flashes of genius which at intervals have marked the progress of the electric era.

Ten years ago, telegraphy, alone of the practical applications of electricity, engaged much of the thoughts of electricians; the word telephone was scarce heard; and electric light machines and motors were but emerging from the magneto-electric (as distinguished from the electro-magnetic) type. The need for storage batteries was yet unfelt, and the present lasting qualities of the incandescence lamp yet unattained.

With all the chief advances made in these directions, accompanied, as they have been, by numerous progressions of a minor kind, what vast new fields for exploration, and means therefor, have been opened up! Who can forecast the achievements to be announced during the next decade? It would seem that we are but on the verge of all that man, by means of electricity, can accomplish; and it is possible that those feats of our inventors which have astonished and fascinated the attention of the civilised world are but as summer lightnings to a tempest, compared with the importance of the inventions and improvements yet to come; inventions, the shadows of which are, perhaps, even now detected by the sharpened senses of those who, by assiduous study and thought, have accustomed themselves to foresee results as yet not dreamt of by others of less capacity or mental energy.

Yes, much will be done; and, through the information we from time to time shall publish in our columns, we hope still to be an humble means to this great end. That our endeavours in this direction have been appreciated the results have proved to us, and we shall, with our next issue, enter on the publication of the twelfth volume with the determination to merit, as far as possible, the consideration and kindness which have been showered on us by our readers, and to leave nothing wanting to make the "Review" worthy of the important cause which it advocates, and which it is our ambition to assist.

Our Readers we again ask to strengthen our hands by sending early information, and by contributing to our "Correspondence" columns; and, at the same time, we desire to thank those who have so liberally responded to a similar request we made at the commencement of this year. Indeed so bountifully were our wishes responded to that the requirements of our "Notes" and "Correspondence" columns demand some immediate consideration on our part to enable us to place all the information before our readers which is constantly flowing freely towards our pages.

Beyond some slight alterations in the conduct of these columns we do not contemplate any change, of importance, in our programme; the great success of the last year having convinced us that our existing arrangements have given a larger amount of satisfaction to our subscribers than we had even dared to hope. With their assistance, and encouraged by the numerous kindly expressions of sympathy in our work which we at various times have received, we shall go forward to the labour of another twelve months, feeling that correct information on subjects electrical, combined with criticism unbiassed by fear or favour, are what our readers require, and what we should, and are determined to supply.

"Rien n'est beau que le vrai."

ELECTRICAL EXHIBITIONS.

By W. H. PREECE, F.R.S.

(Paper read before the Society of Arts, on Wednesday, the 13th inst.)

(*Continued from page* 488.)

A VERY interesting exhibition of quite a different character took place in September and October last, in Munich. Though it was called international, it was purely German. There were only 170 exhibitors, but what was shown was good. The principal object aimed at was to display in the very best artistic manner, the power of electricity to illuminate space, and this was done with very great success. In the centre of the building an exceedingly handsome fountain, brilliantly lit up by coloured rays, played in the centre of a pretty garden, laid out with great taste and care.

Here we saw a quaint representation of the past and present. The past—an old hut or cottage, furnished with the oldest and blackest oak, a plain and simple table and stool, a spinning wheel, a crucifix, an iron clock, lit up by an old greasy oil lamp. The present—a well-arranged library of the present day, fitted up with the most artistic and expensive furniture, and all that luxury, wealth, and taste could command, beautifully illuminated by glow lamps.

In the nave there was a copy of an old Norman church, fitted up inside with all the appurtenances of a church, a lay figure kneeling before a lectern, with all the gorgeous robes of a high dignitary of the church of Rome, and upon whom was playing the brilliant ray of an arc lamp. The effect was picturesque and striking.

There was also a theatre capable of holding 300 people, fitted with a stage, footlights, set scenes, &c., in which, every evening, pantomimic representations took place to show how electricity was adaptable for stage effects. There was also a picture gallery so illuminated. The chief feature at the exhibition was the transmission of power from the falls of the Iser at Hirschau, 5 kilometres off, to the building, and also from Miesbach, 57 kilometres (34 miles) off. The latter experiment was made by Marcel Deprez. Two wires were used, and half a horse-power was obtained. The experiment was the same as though a waterfall at Bath worked a circular saw in this room.

There was a new lamp shown, about which we may hear something further. It is the invention of a Signor Cruto, an Italian, who for 12 years has devoted his time to discovering a mode of constructing artificial diamonds, and has ended by producing a glow lamp! The lamp consists of a *tube* of carbon, and requires only half an ampère to work it, a result which, if carried out, will be of immense economy and importance. The production of the electric light has already been brought well into economical comparison with gas, and it only wants two or three inventions

glass, just behind which a small mirror is fixed at an angle of 45° to the axis of the tube. This mirror is supported from the centre of the transverse opal disc in such a way that the support is hidden from the observer by the mirror itself—an arrangement which ensures the apparent juxtaposition of the illuminated surfaces which have to be compared. The light to be measured is placed on the right-hand side of the photometer and the wedge turned with the collar, so that the light falls normally upon the face of the wedge, passes through the wedge, through the pane of opal glass, and is incident upon the mirror, which reflects it to the eye of the observer. The wedge is shifted to interpose a greater or less thickness of the absorbing medium, till a balance is obtained, that is, until the apparent illumination of the mirror is equal to that of the field of comparison in the middle of which it is seen. If the range of the wedge is insufficient to admit of this, the degree of illumination of the field is altered by means of the diaphragms.

The employment of glass wedges for photometric comparisons is not new, having been already used by both Xavier de Maistre and Quetelet; but no practical photometer based upon this method has hitherto been constructed. The employment of diaphragms for increasing the range of the wedge is found to work well, and to enable the observer to adjust the illumination of the field with exactitude, the bright part of the paraffine flame being, of course, kept opposite to, and so as to well cover, the diaphragm aperture.

A table is constructed giving for each position of the wedge and for each diaphragm the value in standard candles of any light placed at one metre distance from the instrument; and if the light be placed at any other distance, the number in the table has simply to be multiplied by the square of the actual distance in metres.

For ascertaining approximately the amount of light which passes through any given coloured glass—such, for example, as orange glass—the eye-piece is furnished with a disc, containing small panes of white and different coloured glasses, either of which can be interposed at pleasure.

This photometer is made by Messrs. Elliott Bros. in two forms: one for use as a portable photometer, as in the figure, and the other on a more solid stand, for laboratory purposes.

ON THE CURRENTS PRODUCED BY NITRATES IN IGNEOUS FUSION ON CONTACT WITH CARBON HEATED TO REDNESS.

By M. BRARD.

In a former paper (November 13th last) I indicated the result of my experiments on the properties of nitrates in contact with incandescent carbon.

To utilise these properties I undertook a first series of researches in order to obtain a special combustible which, burning in any furnace, might produce directly heat and electricity. In a second series I have undertaken, on the contrary, to realise a special furnace in which these physical agents may be produced with any combustible.

1. *Electrogenic fuel.*—My first attempt in this direction was the preparation of a small instrument which I call the electrogenic candle. This candle was made up of an agglomeration of coal-dust, cemented together with treacle in a mould where it was compressed with wires. These wires, issuing at one end of the little cylinder of carbon, form the negative pole. This agglomeration was then wrapped in a slender sheet of asbestos paper, which is in turn covered with copper wires constituting the positive pole. Then the whole is repeatedly steeped in a bath of melting nitrate, so as to form a coating of five to six millimetres in thickness.

The apparatus thus constructed has a rude resemblance to a candle, of which the carbon is the wick, whilst the nitrate takes the place of the wax. If the two poles are then connected by a galvanometer and the carbon heated to redness an energetic deviation of the needle is observed. This deviation persists during the whole duration of the combustion with abrupt variations indicating great variations of intensity. When once kindled the carbon continues to burn alone, melting briskly and giving a flame of great brilliance.

This candle burns quickly; the pure nitrate, which melts in contact with the ignited carbon, attacks it too energetically; the circumference of the charcoal before the centre is burnt is covered with a layer of a refractory salt which injures the continuity of the chemical action. Besides, the conducting wires lodged in the nitrate are more or less affected by the vivacity of the combustion. All these causes combined explain the variation in the intensity of the current. To make the candle a regular source of electricity and heat, it is necessary to eliminate these causes by alternating the combustion energy of the nitrate. I have effected this by mixing with the salt an inert body, such as a carbonate, and particularly ordinary ashes, which I introduce into the nitrate bath in the proportion of 2 parts ash to 1 part of nitrate. Under these conditions the carbon burns regularly; it is no longer encrusted, and does not melt at the point of contact of the mixture. The current acquires a remarkable constancy.

This result being acquired, it became possible to produce a true electrogenic combustible. The *briquette battery*, which I have constructed on this principle, is an agglomeration of ordinary coal, upon which rests a tablet of a mixture of nitrate and ashes, in the proportions mentioned above and separated from the coal by a thin sheet of asbestos paper. The poles of this element are constituted by metallic rods, which traverse the carbon and the nitrate and appear at one end of the mass. If one of these *briquettes* is in the fire by the end opposite to its poles, the carbon becomes red-hot, the nitrate melts, and a current is set up, feeble at first, but becoming more and more intense, until it reaches a maximum, which remains constant as long as the intensity of combustion in the fire remains constant.

Two of these *briquettes*, connected in tension, decompose water.

I hope to improve the yield of this battery, the specimens of which produced in the laboratory by hand are still rude. I hope to increase the electromotive force by mixing with the nitrates chlorates, the oxidising power of which is greater, and to lessen the resistance by omitting the sheet of asbestos, which the considerable resistance of the black carbon seems to render needless.

2. *Electrogenic furnace.*—The attempts which I have made to obtain a furnace producing directly heat and electricity with any combustible whatsoever, have not succeeded completely, because of the difficulty of insulating the elements. Still the results obtained show that the object in view is not impracticable.

We may conceive above a fire a central reservoir, containing nitrate kept in fusion, and letting this liquid flow in a constant and uniform manner upon inclined gratings. On these gratings rests the carbon of a series of small isolated fires, converging around a common centre. The construction of these fires is such that combustion ensues only on a limited space, near the grate which closes the lower extremity. Hence the combustion of the carbon in each fire takes place precisely where the melted nitrate flows. Metallic conductors or bars traverse the coal in each fire, and advance towards the nitrate-grate, which they approach as near as possible without actual contact.

The working of such an apparatus is explained easily; the ignited carbon and the melted nitrate meet in the conditions desired to produce a constant current. Each small furnace constitutes an element of which the nitrate-grate forms the positive pole, and the bars traversing the carbon the negative pole. The apparatus already constructed on this principle show that it is really thus. But hitherto I have not been able to avoid considerable losses by derivation and have been unable to obtain tension currents.—*Comptes Rendus.*

The Gilchrist Lectures.—In our notice of these lectures recently delivered in Scotland (see Electrical Review of the 9th inst.), we spoke of the lecturer as Dr. Carpenter. We should have said William Lant Carpenter, Esq., B.A., B.Sc., &c. We may add that a perusal of the syllabus of the lectures shows them to have been of a most instructive nature.

UPON THE ELECTRICAL EXPERIMENTS TO DETERMINE THE LOCATION OF THE BULLET IN THE BODY OF THE LATE PRESIDENT GARFIELD;

AND UPON A SUCCESSFUL FORM OF INDUCTION BALANCE FOR THE PAINLESS DETECTION OF METALLIC MASSES IN THE HUMAN BODY.

By ALEXANDER GRAHAM BELL.

(A paper read before the American Association for the Advancement of Science, at the Montreal Meeting, August, 1882.)

(*Continued from page* 493.)

Original Experiments.

IN the theoretical arrangement recommended by Profs. Trowbridge and Rowland (fig. 6) the primary coil, A, was of smaller diameter than the secondary, B. This had given us no better effects than the ordinary form of Hughes' balance (*see* fig. 2), in which the two coils, A, B, were of equal diameter. We then tried the effect of making the primary coil, A, of greater diameter than the secondary, B (*see* fig. 7), and in this case we appeared to obtain an increase of hearing distance. Five centimetres (2 inches) was, however, the utmost limit reached, when, on July 19th, Mr. J. Stanley Brown and Dr. Woodward visited my laboratory and witnessed some experiments. No difficulty was experienced in detecting a bullet held in the mouth by passing the exploring coil over the cheek; and the presence of a flattened bullet held in the clenched hand was also readily determined. Dr. Bliss, Dr. Reyburn, and Surgeon-General Barnes visited the laboratory next day and expressed themselves as very hopefully impressed by the experiments. These were subsequently repeated in the surgeon's room at the Executive Mansion for the information of Dr. Frank Hamilton and Dr. Agnew, who also seemed favourably impressed.

Such opinions from the surgeons in attendance upon the President, and the continued interest shown by Prof. Newcomb, encouraged me to proceed with the experiments.*

It was now determined to test the effect of each convolution of the primary coil, so as to arrive empirically at some idea of the best shape of coil. For this purpose Mr. Tainter constructed the instruments shown in fig. 8. Circular grooves were turned in two boards, one of which is shown in perspective at A and the other in section at D. An insulated copper wire could be pressed into any of these grooves so as to give the wire an exactly circular shape of known diameter, and the two ends were passed through an orifice in the back of the board, making connection with a similar ring of wire in the other instrument, as shown. A small secondary coil, B, of fine wire, which could be moved with moderate friction upon the horizontal rod, was connected to another similar coil, E, and to a telephone; and a small brass ring, C, which could also be moved along the horizontal rod, was used instead of a bullet to disturb the balance.

In making an experiment with this apparatus the secondary coil (B) was first placed within the primary ring and in the same plane with it, and the balancing coil, E, was adjusted to produce silence. The brass ring, C, was then moved along the horizontal rod until the balance was sensibly disturbed and the relative distances of the coils and the brass ring were noted.

Continuing the experiment the coil, B, was moved a determined distance beyond the plane of A, and the balancing coils again adjusted to silence. The brass ring, C, was once more caused to disturb the balance, and the new hearing distance was noted. The following are the tabulated results of a series of experiments made on the 19th of July, 1881. The battery employed consisted of six bichromate cells connected in series.

Diameter of Primary Ring.	DISTANCE BETWEEN—			Diameter of Primary Ring.	DISTANCE BETWEEN—		
	A B	B C	A C		A B	B C	A C
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
	0	17	17		0	27	27
	5	14	19		5	20	25
30	10	13	23	159	10	18	28
	20	9	29		20	17	37
	30	7	37		30	14	44
	50	0	50		50	14	64
	0	17	17		0	12	12
	5	19	24		5	18	23
50	10	26	36	206	10	25	35
	20	17	37		20	19	39
	30	14	44		30	22	52
	50	5	55		50	18	68
	0	21	21		0	20	20
	5	23	28		5	18	23
81	10	23	33	253	10	20	30
	20	18	38		20	19	39
	30	14	44		30	23	53
	50	12	62		50	20	70
	0	22	22				
	5	25	30				
113	10	27	37				
	20	26	46				
	30	26	56				
	50	17	67				

These figures show that *the distance from the primary coil,* A (*fig.* 8), *at which the influence of the brass ring,* C, *became perceptible increased with the diameter of the primary ring, and that the secondary coil,* B, *required to be projected considerably beyond the plane of the primary in order to obtain th maximum effect.*

The conclusion seemed a natural one that the degree of projection, A B, of the secondary coil should proportionally increase with the diameter of the primary ring, but the tabulated figures did not fully justify the inference.

The experiments had necessarily occupied a considerable time, and I thought that the difference between the results that should have been observed, according to the above hypothesis, and those that were actually obtained, might have been due to the gradual exhaustion of the bichromate battery employed and to its polarisation, although every care had been taken to preserve its power by removing the carbon and zinc plates from the solution, excepting when an observation was made. To test whether the battery exerted any material influence upon the hearing distance, a further series of experiments was made with the same battery.

It will be seen by reference to the tabulated statement shown above that the maximum hearing distance, B C, had been obtained with a primary ring 11·3 cm. in diameter when the distance, A B, between the primary and secondary coils was one centimetre. This arrangement of the apparatus was, therefore, adopted throughout the following experiments:—

		Hearing Distance; mm.
1. Apparatus tried with 1 cell (bichromate battery) ...	(B C, fig. 8) =	9
2. Six cells in series	(B C, fig. 8) =	16
3. Six cells in multiple arc	(B C, fig. 8) =	9
4. Six cells in two series of 3 each	(B C, fig. 8) =	15
5. Same experiment repeated	(B C, fig. 8) =	13·5
6. Same experiment repeated by Mr. Tainter	(B C, fig. 8) =	12·5

These experiments proved that battery power *did* exert an influence upon hearing distance, and also that the battery in use was gradually deteriorating.

I concluded, therefore, that if the battery power had remained constant, the hearing distance might not only have been proportional to the diameter of the primary ring, but, in order to attain the maximum effect the projection of the secondary coil beyond the plane of the primary might also have been found to increase in like proportion.

This led me to try the effect of a conical primary coil, A, with the secondary, B, at its apex, as shown in fig. 9, but the hearing distance for a bullet was only 3·5 cm.

Singularly enough Mr. J. H. C. Watts, in Baltimore, had independently arrived at a very similar form of coil and with

* I desire especially to express my gratitude to Dr. Frank Hamilton for words of encouragement spoken at a later date when sympathy and encouragement were greatly needed.

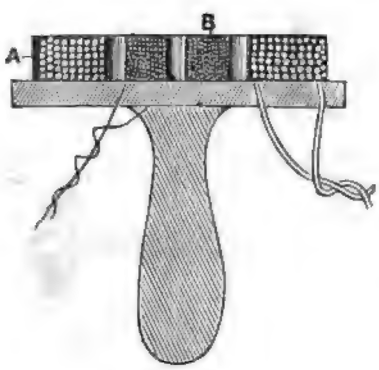

FIG. 7.

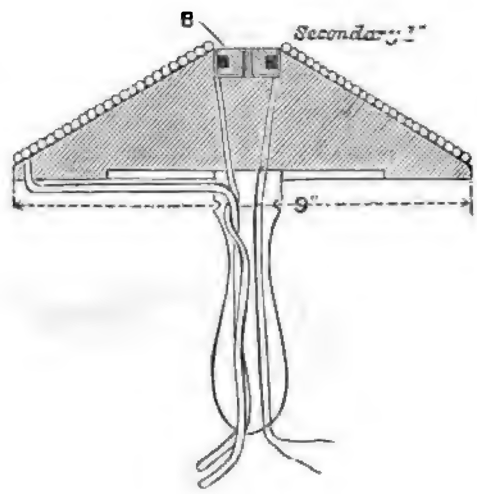

FIG. 9.

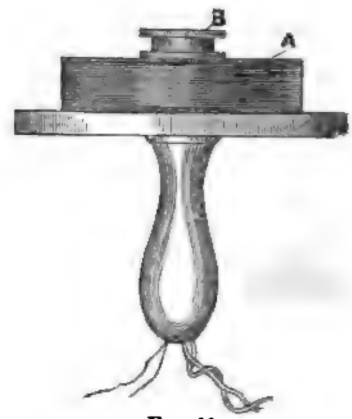

FIG. 11.

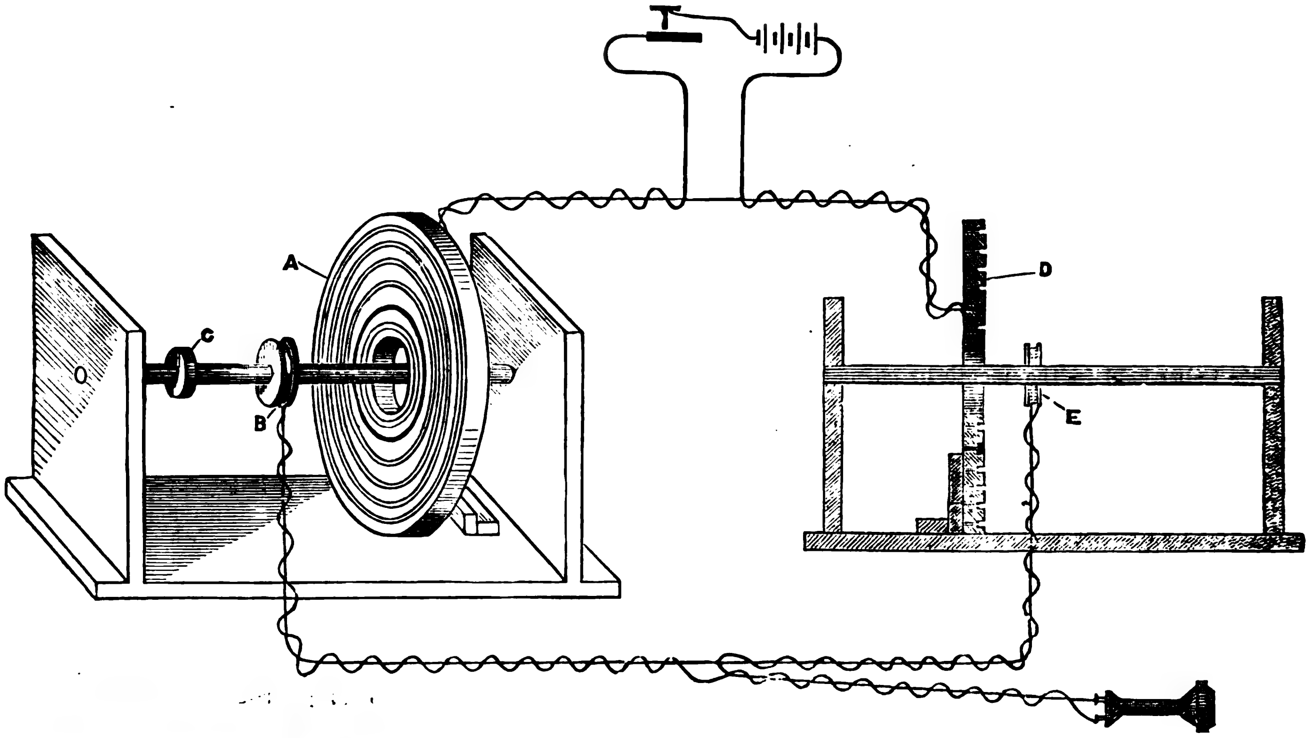

FIG. 8.

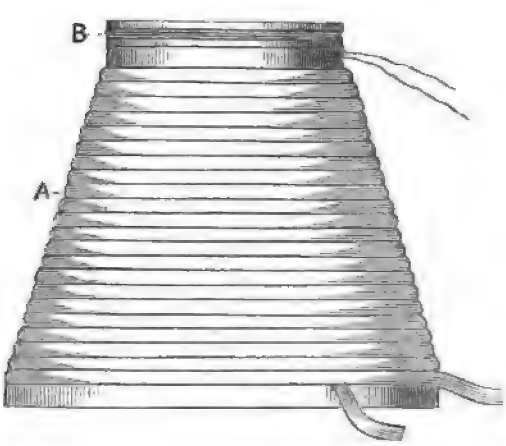

FIG. 10.

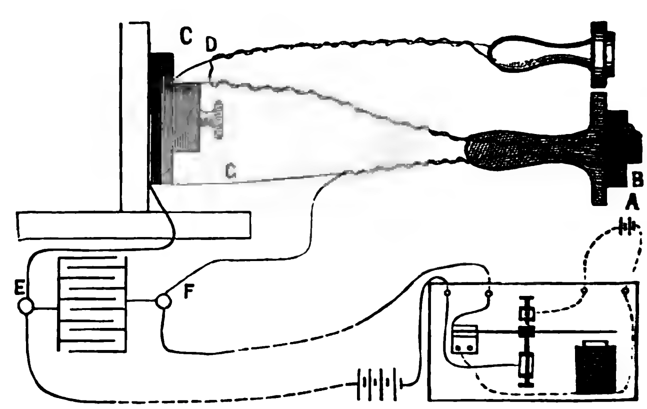

FIG. 13.

Arrangement of apparatus used in the first experiment upon the late President Garfield, July 26th, 1881.

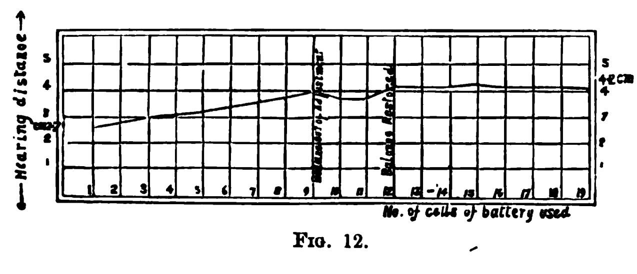

FIG. 12.

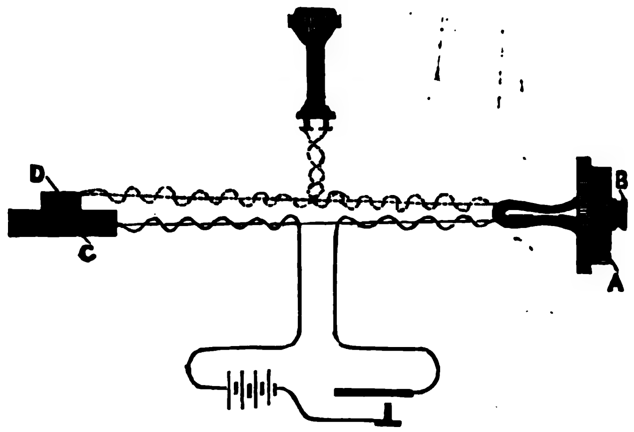

Fig. 14.

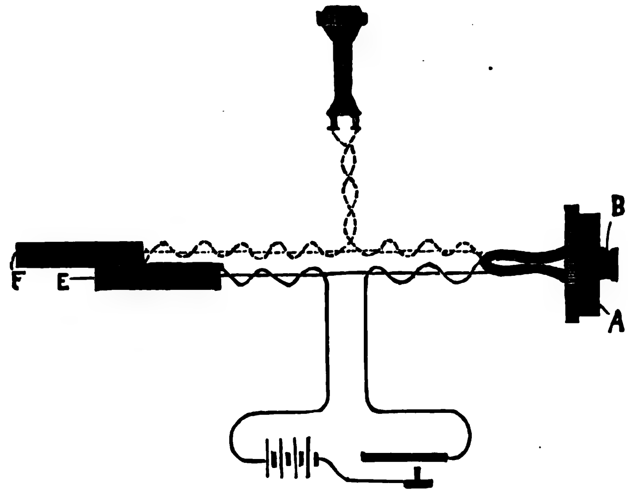

Fig. 15.

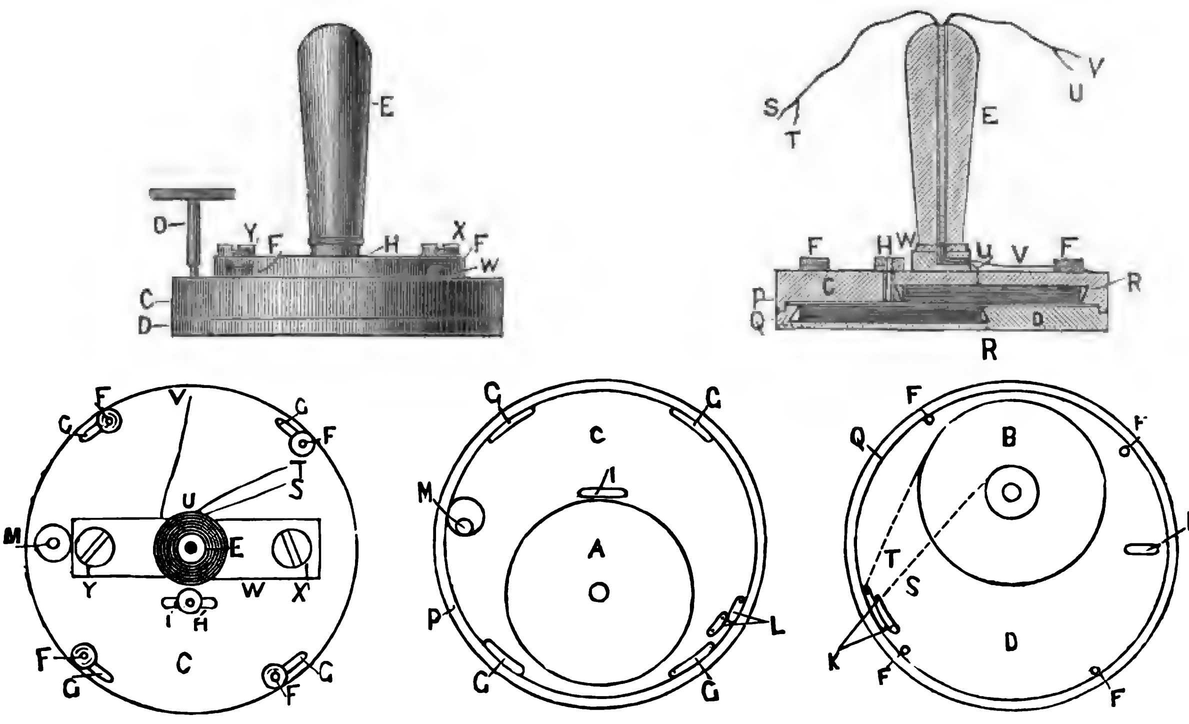

Fig. 20.

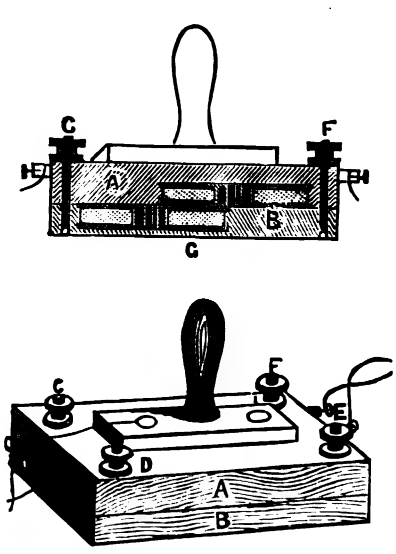

Fig. 18.
Apparatus used in the second experiment upon the late President Garfield, August 1st, 1881.

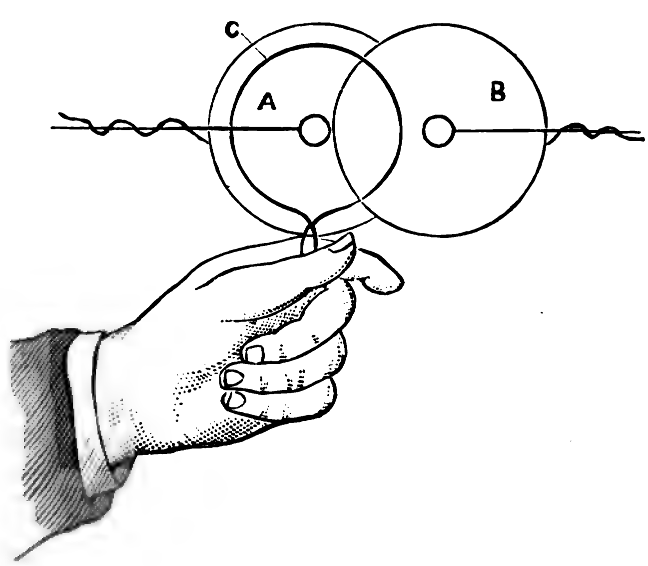

Fig. 19.

the instrument shown in fig. 10 he had obtained at one time a hearing distance of 7·5 cm. (or three inches), but from some cause not ascertained he was unable subsequently to reproduce the effect.

The final form of apparatus adopted as the result of the above experiments is shown in fig. 11. With this arrangement and a battery of six bichromate elements freshly set up, we were always sure of a hearing distance of at least 5 cm., although after the battery had been in use for some time the hearing distance hardly exceeded 4 cm.

The following are the dimensions of the coils A B (fig. 11) and their resistance :

COIL A......	External diameter	7 cm.
	Internal diameter	4·5 cm.
	Depth	2·4 cm.
Wire used, No. 23 (cotton covered).	Resistance. 2 ohms.	
COIL B......	External diameter	2·3 cm.
	Internal diameter	8 mm.
	Depth	8 mm.
Wire used, No. 36 (silk covered).	Resistance, 75 ohms.	

The face of the coil B projected beyond the face of coil A 4 mm.

The balancing coils were made as nearly as possible the duplicates of A and B. The resistance of the coil of the telephone employed was 75 ohms.

Influence of Battery Power.

The following experiments were made with this apparatus (fig. 11) on July 20th, 1881, to test the influence of battery arrangements upon the hearing distance of a leaden bullet.

I.—SERIES OF EXPERIMENTS WITH A BICHROMATE BATTERY WHICH HAD PREVIOUSLY BEEN IN USE FOR A FEW MINUTES.

	Hearing distance of leaden bullet as observed by—	
	A. G. Bell.	S. Tainter.
	cm.	cm.
1 cell	2·4	2·6
2 cells in series	3·3	3·5
3 cells in series	3·7	4·1
4 cells in series	3·7	4·0
5 cells in series	4·0	4·1
6 cells in series	4·3	4·4
6 cells in multiple arc	2·6	2·9
6 cells in two series of 3 each ...	3·8	3·7
6 cells in three series of 2 each ...	4·3	4·0

II.—SERIES OF EXPERIMENTS WITH A LECLANCHÉ BATTERY OF TWENTY CELLS WHICH HAD BEEN SET UP FOR ABOUT ONE MONTH. IT HAD BEEN KEPT NORMALLY UPON OPEN CIRCUIT, AND HAD ONLY BEEN OCCASIONALLY USED.

	Hearing distance.
20 cells in series	3·3 cm.
20 cells in 10 series of 2 each	3·6 cm.
20 cells in 5 series of 4 each	4·1 cm.
20 cells in 2 series of 10 each	3·0 cm.

Although the battery appeared to be in good condition, a close inspection showed that the connections were dirty, and that one of the zinc wires was half broken through.

The defective cell was now removed from the circuit and the connections of all the other cells cleansed and tightened.

III.—THE FOLLOWING EXPERIMENTS WERE THEN MADE WITH THE LECLANCHÉ CELLS UNITED IN SERIES :—

No. of cells.	Hearing distance.	No. of cells.	Hearing distance.
	cm.		cm.
1	2·7	11	3·8*
2	2·8	12	4·2
3	3·0	13	4·2
4	3·3	14	4·2
5	[illegible]	15	4·3
6	[illegible]	16	4·2
7	[illegible]	17	4·2
8	[illegible]	18	4·2
9	[illegible]	19	4·2
10	[illegible]		

* Balance not quite perfect.

These results are graphically represented in fig. 12.

It will be observed that the hearing distance was carried nearly one third as far again as at first, simply by increasing the number of cells employed without any other change in the arrangement. It will also be noticed that the apparatus requires to be adjusted to complete silence in order to obtain the maximum effect.

As a general result of all our experiments with voltaic batteries we find that *it is advisable to use a battery possessing great electromotive force and slight internal resistance, and to connect the cells in series.*

Experiments upon Living Subjects.

On the 22nd of July an experiment was made, at the request of Dr. Bliss, upon the person of Lieut. Simpson, who had carried a bullet in his body for many years.

When the exploring instrument (fig. 11) was passed over the lieutenant's back a sonorous spot was found, but the indications were too feeble to be implicitly relied upon. Imagination very easily conjures up a feeble sound like that observed, but a number of experiments by different observers seemed to indicate that in this case there was an external cause for the sound—probably the presence of a very deeply-seated bullet. The results of this experiment were communicated to Dr. Bliss, in a letter dated July 23rd, 1881.

On the 25th of July Prof. Rowland visited me at Washington and suggested the use of a condenser in the primary circuit. I had previously discussed this idea with Mr. Tainter, but, not having a condenser at hand, we had been unable to make any experiment. After our conversation with Prof. Rowland, however, we were so impressed by the importance of the point that we obtained a condenser next morning, and found it to produce not only a different quality of sound when the bullet approached the coils, but also to increase the hearing distance of the instrument shown in fig. 11 at least one centimetre.

On the evening of the same day (July 26th) our apparatus was carried to the Executive Mansion and an experiment made upon the person of the President.

From some cause then unknown a balance could not be obtained, and the results were, therefore, uncertain and indefinite. It was discovered afterwards that a mistake had been made in the mode of connecting the condenser. The latter should have been connected at E F (fig. 13), whereas it was placed at E G, thus influencing only one, instead of both, of the primary coils.

With the condenser properly arranged experiments were tried on July 29th and 30th on three soldiers from the Soldiers' Home who had been wounded during the Civil War, namely, John Teahan, Asa Head, and John McGill.

In the case of John Teahan no results were obtained. In the case of Asa Head, who had a buckshot in the cheek, loud and well-marked sounds were heard in the telephone; and in the case of John McGill, who was supposed to carry a bullet in his back, no results were obtained.

Further efforts were then prosecuted for the improvement of the apparatus.

Further Experiments to Improve Apparatus.

Our attention had hitherto been directed chiefly to modifications of the exploring instrument. We now investigated the effect, upon the hearing distance, of the coils used to obtain a balance.

The following experiments, made July 29th, 1881, bear upon the point :

EXP. 1. (See fig. 14.) Resistance of primary, A, of exploring instrument, 2 ohms; resistance of primary, C, of balancing coils, also 2 ohms; resistance of exploring secondary, B, 140 ohms; and of balancing secondary, D, 120 ohms.

Result : Hearing distance of bullet from explorer, A B, 3·5 cm. Hearing distance from balancing coils, C D, also 3·5 cm.

EXP. 2. (See fig. 15.) Same exploring coils as in Exp. 1, but balancing coils consisted of a flat primary, E—resistance, 5·30 ohms; and flat secondary, F—resistance, 83 ohms. The adjustment was made by sliding the secondary coil upon the primary until a position of silence was obtained.

Result : Hearing distance from explorer, A B, 1·5 cm. Hearing distance from E F, 3 cm.

As a general result of our experiments we found that *every increase in the resistance of the balancing coils (especially the primary) reduced the hearing distance of the exploring instrument*, and it became, therefore, desirable to do away with this source of resistance as much as possible.

Return to Original Form of Apparatus.

This led us back to the original form of apparatus that had first occurred to me (see fig. 1), in which a single pair of coils was employed. A few other experiments, made July 29th, 1881, will show the importance of the point attained.

EXP. 3. The two flat coils, E F, used in Experiment 2 were arranged as in fig. 16, so as to form a balance by themselves.

Result: Hearing distance, 7 cm.

In all these experiments the battery used consisted of four cells (Leclanché).

EXP. 4. The same coils used in Experiment 3 were tried

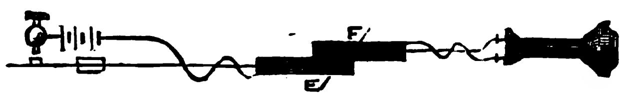

FIG. 16.

again, as shown in fig. 16, but with a battery of eight cells (Leclanché).

Result: Hearing distance, 8·7 cm., or nearly 3½ inches—a result quite unprecedented in our experiments.

The following are the dimensions of the coils, E F:

COIL E....	External diameter	10 cm.
	Internal diameter	2·5 cm.
	Depth	1 cm.
	Wire used, No. 23, (silk-covered).	
COIL F....	External diameter	10 cm.
	Internal diameter	2·5 cm.
	Depth	1 cm.
	Wire used, No. 28 (silk-covered).	

EXP. 5. The same coils, E F, used in Experiments 2, 3, and 4, were tried once more with a battery of six large bichromate elements, and with a condenser, G, in the primary circuit, as shown in fig. 17.

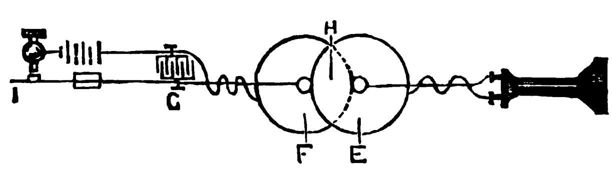

FIG. 17.

Result: Hearing distance 13 cm., or more than 5 inches.

This great increase in hearing distance seemed to be chiefly due to the condenser, for upon disconnecting it the hearing distance was little more than 9 cm., but further experiments proved that other causes also contributed to the result.

EXP. 6. When the condenser was in circuit and the leaden bullet close to the coils (arranged as in fig. 17), the sound produced by the telephone was a musical note whose pitch was the same as that normally produced by the vibration of the reed of the interrupter. Mingled with this tone could be distinguished a number of feebler tones of very much higher pitch. Upon withdrawing the bullet gradually from the coils the fundamental sound became fainter, and one of the high upper-partial tones gradually acquired prominence; and at a distance of about 8 or 9 cm. the fundamental could no longer be distinguished, but the high tone persisted, and was clearly audible up to a distance of 13 cm. The effect was very striking, and when the bullet was moved to and fro parallel to the plane of the coils, E F, at a distance of about 10 cm., the telephone emitted a shrill, whistling sound each time the sensitive area (H) was passed.

It was noticed that other metals, such as iron, brass, and copper, did not seem to reinforce this high tone to any great extent, but brought out the fundamental at every distance where an effect was produced.

EXP. 7. The condenser, G (fig. 17), was removed from the circuit and the leaden bullet held about 4 or 5 cm. from the coils, E F. The fundamental tone was heard, and the characteristic upper-partial could also be distinguished, but it was only faintly audible. Upon now suddenly replacing the condenser the high upper-partial tone was instantly reinforced as if by a resonator.

EXP. 8. The rheotome employed to interrupt the primary circuit (which had been placed in a distant room) was found to be vibrating badly. The reed, I, of the instrument (see also fig. 5) was rattling against its contact pieces, thus producing an impure sound, and I could distinguish amongst the upper-partials the tone that had been reinforced by the condenser. Upon screwing up the contact pieces so as to improve the vibration I could no longer distinguish the particular upper-partial referred to, and upon returning to the room in which the coils, E F (fig. 17), were placed I could no longer detect the effects noted above in Experiments 6 and 7, and the hearing distance did not exceed 9 cm.

The peculiar effects obtained with the arrangement shown in fig. 17 *thus seemed to depend* (1) *upon a particular kind of vibration of the reed of the interrupter, producing a certain high upper-partial or overtone,* (2) *upon the use of a condenser acting as a sort of electrical resonator for this tone, and* (3) *upon the use of the metal lead.*

Mr. Marean, of Washington, kindly lent me a number of condensers used by the Western Union Telegraph Co., and we found, upon connecting them with the coils, E F, as shown in fig. 17, and holding a leaden bullet near the coils, that each condenser reinforced a high upper-partial of different pitch. We arranged the condensers so that they could be successively introduced into the circuit with great rapidity. The effect was very curious and sounded somewhat like a Scotch air played upon the bag-pipes. The low hum of the fundamental could be heard continuously, like the drone of the bag-pipe, while the higher tone changed its pitch with each change of condenser.

The pitch of the high tone reinforced seemed to depend upon the electro-static capacity of the condenser employed, but the exact relation between the two has not been ascertained. In Experiments 5, 6, 7, 8, and the subsequent experiments described above, the battery employed consisted of six pairs of carbon and zinc plates of large area placed in a solution of bichromate of potash containing sulphuric acid.

The effects noted above were not produced satisfactorily when the battery was much run down, nor were they obtained with a Leclanché battery which had been set up for some time, but which appeared to be in good condition.

It is evidently necessary in order to produce this characteristic high tone to use a battery possessing considerable electromotive force and slight internal resistance.

Our experiments had reached this stage when, on Saturday, the 30th of July, 1881, I was requested to make another trial upon the person of the President at the evening dressing of the wound.

At this time, however, we had no exploring instruments completed excepting one or two like that shown in fig. 11; for it will be understood that the promising results noted above had been obtained from coils that were simply placed upon a table and adjusted by hand.

We immediately proceeded to the Executive Mansion with the apparatus shown in fig. 13, prepared to make a trial, if it was deemed advisable; but, upon learning of the results of our later experiments, the surgeons resolved to postpone any further trial until we could arrange the coils (fig. 17) in a portable form.

By forced exertions the coils were arranged that same night in a wooden case, as shown in fig. 18. This case consisted essentially of two oblong blocks, A B. A shallow circular recess was turned out in each block for the reception of one of the coils, and the two blocks were held together by four pins of ebonite, C, D, E, F, which passed up through slots in the upper block and were secured by ebonite thumb-screws.

When the instrument was completed I found to my great distress that a balance could not be obtained by any adjustment of the apparatus. There was a position of minimum sound, and the telephone responded to a bullet presented to the central part, G, of the instrument; but the hearing distance did not exceed 3 or 4 cm., whereas we had obtained

with the same coils before the construction of the wooden case a perfect balance and a hearing distance of 13 cm.

After numerous unsuccessful experiments had been made to ascertain the cause of the difficulty, it occurred to me that if two adjoining convolutions in one of the coils made contact at any point, a circuit of low resistance would be formed (a single ring of wire in fact), in which the induced currents might circulate without reaching the telephone connected with the apparatus. I had previously measured the resistance of the coils without discovering any defect, but when I considered the large number of convolutions in each coil it seemed possible that a defect of this kind might exist which could not be discovered by a Wheatstone Bridge, excepting by very delicate and accurate observations. To test whether a short-circuited convolution would produce effects analogous to those observed, a piece of copper wire was bent into an annular form, and the ends connected together. On bringing this metallic ring near a pair of coils, A B, fig. 19, properly adjusted to silence, the balance was loudly disturbed. The copper ring, C, was held as shown in fig. 19, and the balance could not then be restored by any adjustment of the coils. A position of minimum sound was all that could be obtained, and the hearing distance was enormously reduced. This was *prima facie* evidence of the nature of the defect.

The coils (fig. 18) were then removed from their case, but a cursory examination revealed no defect. Upon trial, however (being arranged as formerly in fig. 17), a balance could not be obtained, and the hearing distance was only about 4·4 cm. The defect was thus definitely located in the coils themselves.

Upon close examination it was noticed that the outside convolutions of the primary coil were slightly frayed at one part, but it appeared hardly possible that so great a defect could be due to so apparently slight a cause. However, to test the matter, I removed the outside layer of wires and then tested the coils result again.

Result: The defect had vanished—a perfect balance was obtained, and the hearing distance was again 13 cm.*

The coils were then replaced in their case, and the completed instrument tested. The lower wooden block, B (fig. 18), was adjusted by hand as nearly as possible to the position of silence, and then the thumb-screws, C, D, E, F, were tightened.

The balance now obtained was not quite perfect, but by striking the lower block, B, a few smart blows with a wooden mallet we were able to reduce the arrangement to complete silence.

The instrument was then in such a sensitive condition that it could scarcely be moved without affecting the balance. Upon gently swaying it backwards and forwards a pulsation of sound was heard at every swing.

When the motion was carefully made, so that it was always in the same place, no pulsations were observed. They only occurred when the inclination of the coils was changed.

This defect was found to be due to the bulging of the thin portion, G, of the wooden case (fig. 18) under the weight of the enclosed coil, and the simple pressure of a finger on this portion of the case disturbed the balance. The movement of the lower coil when the instrument was swayed about must have been inconceivably small, but on account of the extreme sensitiveness of the arrangement, it produced a perceptible effect upon the balance.

The pulsating sound did not seem to interfere with the detection of a bullet held in the clenched hand, nor did it seem to affect the hearing distance. I therefore despatched a messenger to the Executive Mansion (Sunday morning, July 31st), with a note for Dr. Bliss, to let him know that the instrument was in a condition to be used, should any necessity arise for an immediate experiment. At the same time I informed him that the apparatus in its present form was very crudely constructed, and that I hoped to improve it very greatly in the course of a few days. On Sunday afternoon (July 31st) we sent to the Soldiers' Home for John McGill, upon whom we had experimented the previous day without results (using the apparatus shown in fig. 11).

Upon trying the new instrument (fig. 18) we had no difficulty in finding a sonorous spot in his back, at the place where the bullet was always supposed to be.

This result was at once communicated to Dr. Bliss, and in reply we were requested to make the experiment upon the person of the President next morning.

On Monday morning (August 1st, 1881,) we accordingly removed our apparatus to the Executive Mansion.

The Late President Garfield.

During the former experiment (July 26th) a sudden sonorous effect had been observed upon passing a point near the spot where the surgeons suspected the bullet to be lodged, but I had been unable to verify this by a second observation, although the exploring instrument (A B, fig. 13,) was repeatedly passed over the same place. The sound had been so loud and well marked that I believed at the time it must have been caused by a sudden irregularity in the vibration of the reed of the rheotome used to interrupt the primary circuit, for the arrangement (as explained before) was not perfectly balanced, and any irregularity of this kind would, under these circumstances, have affected the telephone. At the same time the coincidence was remarkable that the exploring instrument should have been at that very time so near the suspected seat of the ball, and this led to the thought that perhaps after all the bullet had been the cause of the sound. I felt confident that the new instrument (fig. 18) would at once decide the question, for the extreme hearing distance of the former apparatus (fig. 13) was only 6 cm., and the apparatus shown in fig. 18 was so superior in this respect that if the sound had really been due to the bullet we should obtain with the new instrument distinct and well-marked effects. When the new explorer (fig. 18) was passed over the suspected spot nothing was heard excepting a slight pulsating sound as the instrument was moved to and fro. This was evidence to me that the former sound had been of accidental origin, whether the bullet was there are not. With the view of eliminating any error of observation caused by the pulsations due simply to the movement of the instrument, I lifted the latter (without changing the inclination of the coils) to a height of about 50 centimetres above the body of the President, and moved it to and fro in as nearly as possible the same way I had done at the lower elevation.

I presumed that if the pulsations heard were due simply to the movement of the instrument, they should occur with equal strength at the two elevations; but if any portion of the sonorous effect was due to the influence of the bullet, the pulsations at the two elevations would be different in intensity. I was struck by the fact that, although the sonorous pulsations were very feeble, they were sensibly louder when the instrument was close to the surface of the body than when it was raised. Continuing the exploration, I found a considerable area over which similar effects were noticed, but upon carrying the instrument towards the back of the President, the difference between the pulsations produced at the two elevations grew less and less, and finally could not be distinguished.

The difference in the loudness of the sound at the two ele-

* These experiments have revealed the cause of the extreme difficulty always experienced in obtaining a perfect balance with coils of fine wire. I have recently used an induction balance to test the condition of the helices that were employed in these researches, and discovered that in a large percentage of cases the insulation was defective. It is possible that some of the results described in this paper (especially of the earlier experiments) may have been vitiated by errors due to defects in the coils that were not suspected at the time. A defect of insulation that is quite immaterial for ordinary purposes may be absolutely fatal to the success of an induction balance. Indeed, so much care is required in this respect that it is extremely difficult to obtain coils that are perfectly suitable for an apparatus intended to search out a bullet embedded in the body. I now make it a rule to test every helix used in induction balance experiments by bringing it up to a system of balanced coils like that shown in fig. 17.

1. If the helix is perfect the balance is not disturbed until the terminals of the coil are connected.

2. If there is a break in any of the convolutions the balance is not disturbed, even when the terminals are connected.

3. If a convolution is short-circuited the balance is disturbed, even though the terminals are not connected, and the sound produced is the fundamental of the rheotome employed to interrupt the primary circuit.

4. If the insulation is defective the balance is disturbed, although the terminals are not connected, and a peculiar spluttering effect is noticed like that produced by a series of sparks.

I propose to apply this method practically as a means of testing the condition of the helices used in the construction of induction coils and those employed in the manufacture of telephones.

vations was so slight that it probably would not have been noticed by an ear unaccustomed to listen to feeble effects, and I feared that the general expectation that the bullet would be found in that part of the body might have led me to imagine a difference that did not exist. For the purpose of eliminating as far as possible any personal error, I requested Mr. Sumner Tainter (who was the only other person present whose ear had been sufficiently trained to be reliable in such an emergency) to repeat the experiments and let me know the result. Upon our return to my laboratory we compared notes, and I found that his observations tallied with mine. He declared he could not obtain a distinctly localised effect, but stated that he had observed a reinforcement of the pulsation over an area of at least two inches in the neighbourhood of the spot to which his attention had primarily been directed, and that he was convinced that the bullet was within that area.

It appeared reasonably certain that the area of feeble sound was due to some external cause, and was not simply an effect of expectancy. In the absence of any other apparent cause for the phenomenon I was forced to agree in the conclusion that it was due to the presence of the bullet, and I so stated in my report to the surgeons. I was by no means satisfied, however, with the results obtained, for no such effects had been observed before in our experiments with bullets. I tried to reproduce the effects by moving the instrument (fig. 18) at different distances over a bullet, but in every case where an effect was produced the sound was quite sharply localised. I thought that perhaps the body of the patient might have affected the result, and so experimented upon a bullet buried in a piece of meat, but no difference of effect was noted. This led me to fear that the extensive area of feeble sound might have been due to some extensive area of metal that was unsuspected at the time, and I proceeded to the Executive Mansion next morning (August 2nd) to ascertain from the surgeons whether they were perfectty sure that all metal had been removed from the neighbourhood of the bed. It was then recollected that underneath the horse-hair mattress on which the President lay was another mattress composed of steel wires.

Upon obtaining a duplicate, the mattress was found to consist of a sort of net of woven steel wires, with large meshes. The extent of the sonorous area having been so small, as compared with the area of the bed, it seemed reasonable to conclude that the steel mattress had produced no detrimental effect.* I was unable to continue experiments with the steel mattress, as just at this time I was obliged to leave Washington on account of illness in my family. Although I was unable for a long time afterwards to carry on personally Induction Balance experiments, the investigations were ably continued under my direction by Mr. Thomas Gleason, in the establishment of Mr. Charles Williams, Jun., in Boston.

Experiments continued in Boston.

Mr. Tainter forwarded from Washington drawings of an improved apparatus he had designed to remedy the defects of the instrument shown in fig. 18, in which the case, adjusting screws, &c., were all to be composed of ebonite.

Mr. Gleason constructed for me a number of such ebonite instruments differing slightly from one another in detail, and the apparatus shown in fig. 20 combined the different points that had been approved.

The two coils, A B, were eccentrically arranged in two circular discs of ebonite, C D, and the adjustment was obtained by means of an ebonite key, O, like the key used for tuning pianos, which turned a cam, M, pivoted in the upper disc and working in a slot, N, in the lower disc.

In order to prevent any movement of the coils, excepting that produced by the adjusting-key, O, each coil was placed in a recess turned out in its ebonite disc, the edges of which were bevelled as shown at R. Paraffine was then poured in so as to fill up each recess. But this alone did not prevent a slight pulsation of sound when the instrument was swayed from side to side, and a very slight pressure of the finger on the thin portion of the ebonite plate under the coil, B, was sufficient to destroy the balance.

This was remedied by strengthening this portion by means of a rod of ebonite which passed up through the centre of the coil and through a slot, I, in the upper ebonite plate, and was clamped firmly after the adjustment of the instrument by an ebonite thumb-screw, H. This, however, increased the difficulties of adjustment. When the coils were adjusted to silence, then the tightening of the thumb-screw, H, disturbed the balance; and if the thumb-screw, H, was tightened first, then the adjustment could only be made by a series of jerks on account of friction. In practice we found it best to adjust the instrument *almost to silence*, and then the tightening of the thumb-screw, H, completed the balance.

This was the form of apparatus at which we had arrived at the time of the death of President Garfield.

The difficulty of adjusting the coils led me ultimately to the idea of the apparatus shown in figs. 21, 22, 23, 24, which is the most practical form of the instrument yet devised.

The two exploring coils, A B (fig. 21), are arranged as

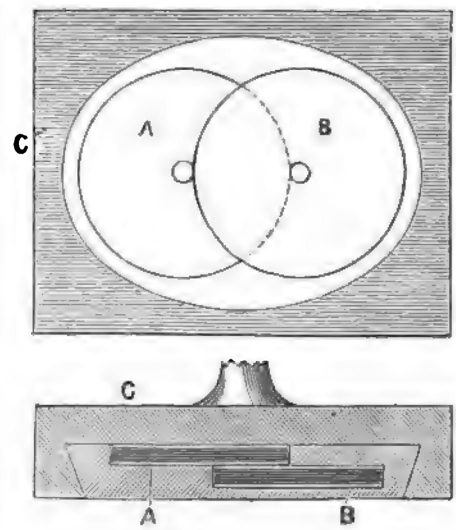

Fig. 21.

shown, in a recess turned out in a single block of wood, C.

The coils are temporarily connected with a telephone, battery, and rheotome in the manner shown in fig. 1, so that they may be adjusted by hand to form a balance. When they have been arranged in their position of silence the hollow in the block of wood, C (fig. 21), is filled with melted paraffine. Upon cooling, the two coils are found immovably fixed in one solid cake of paraffine.

As a matter of practice it is found impossible to fix the coils in this way exactly in their position of silence; but by means of two other very small coils, D E (fig. 22), of insignificant resistance, forming a sort of fine adjustment external to the explorer, a perfect balance is easily obtained. In this instrument the swaying of the coils, A B, produces no effect upon the balance.

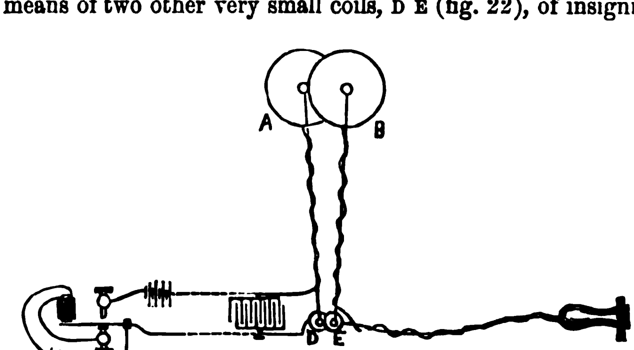

Fig. 22.
Apparatus with which the location of the bullet in the body of Col. Clayton was discovered, October 7th, 1881.

The completed arrangement is shown in plan in fig. 22, and the explorer and balancing coils are shown separately in perspective in figs. 23 and 24.

On account of the small size and slight resistance of the balancing coils, we were enabled to make the adjustable parts of the balancer of metal without practical interference

* The death of President Garfield and the subsequent *post-mortem* examination, however, proved that the bullet was at too great a distance from the surface to have affected our apparatus.

with the sensitiveness of the exploring instrument, and this gave us the power of making very delicate adjustments of the balancing coils.

We found it advisable, however, to avoid placing metal over the sensitive area of the coils, as had been done in the instrument shown in fig. 24.

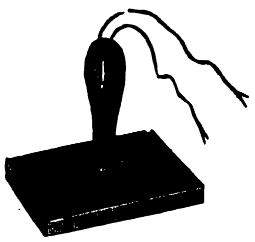

FIG. 23.

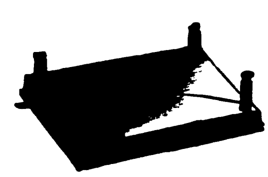

FIG. 24.

In the balancing apparatus shown in fig. 25 (which is the most perfect one yet constructed), the lever to which the upper coil is attached is made of hard rubber.

In fig. 26 is shown the most convenient form of case yet devised for holding the exploring coils.

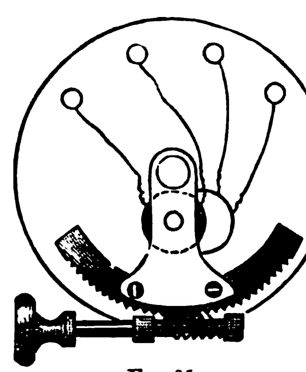

FIG. 25.

By invitation of Dr. Frank Hamilton, experiments were made with it at his office in New York, October 7th, 1881, the instruments used being those shown in figs. 22, 23, 24.

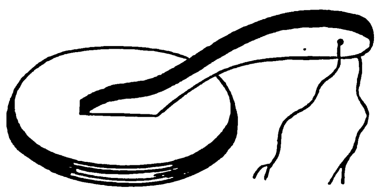

FIG. 26.

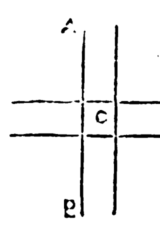

FIG. 27.

As this was the first successful application of the Induction Balance to the discovery of the situation of a ball in the body, the position of which was previously unknown, I may be pardoned for entering somewhat into detail.

I shall quote from the *Medical Gazette** of NewYork an account of the experiments, written by one of the witnesses :

The First Successful Application.

On Friday, October 7th, by invitation, several medical gentlemen,† including the writer, met Prof. Bell at the house of Dr. Frank H. Hamilton, in this city, for the purpose of witnessing the practical application of his improved instrument.

The first person subjected to experiment was General Calvin E. Pratt, judge of the supreme court of the State of New York, and who is now a resident of Brooklyn. General Pratt, at the battle of Gaines' Mills, June, 1862, this being the second day of the famous seven days' retreat across the peninsula, received a ball in his left cheek, which penetrated through the nares and was lodged in the right antrum. Its presence at this time was recognised by his surgical attendant, Dr. Damainville, and its exact position has been known from that day until this, it having given rise at times to much pain and suffering.

General Pratt has been seen by Dr. Hamilton and Dr. Damainville occasionally from that time forward, and they have from time to time urged upon him the necessity of its removal. General Pratt, however, was anxious to know whether Prof. Bell's instrument would indicate its presence at the same point as declared by his surgeons.

The results of the experiment were conclusive and entirely satisfactory to General Pratt, the response being heard distinctly, but rather feebly, by every person present in the room. The feebleness of the response was supposed to be due to the fact that, owing to its situation and the peculiar form of the instrument containing the induction coils, it was impossible to bring the centre of its surface very near the site of the ball, the ball being situated very near the depression at the ala of the nose.

The next patient was Col. B. F. Clayton, who received a wound at the battle of Cedar Mountain, Virginia, Aug. 9th, 1862.

The missile was supposed to be an Enfield rifle ball, and the wound was supposed to be mortal by the medical director of General Banks' staff and his assistants. The ball passed through the sternal end of the left clavicle, and was supposed to have lodged in the muscles under the superior angle of the corresponding scapula. The injury was followed by complete paralysis of the left arm, continuing for a period of six months; and his arm has never yet been completely restored to its normal condition. He suffers a great portion of his time from pains in the arm, shoulder, and portions of the back.

Several small fragments of bone escaped through a fistulous orifice formed near the seat of the original wound.

About eighteen months later an abscess opened on the front of the chest below the fifth rib and to the left of the sternum. Through this sinus his surgeon was able to carry a probe upwards and backwards towards the top of the shoulder several inches, and which sinus was supposed then to communicate with the seat of the ball on the back.

Pleural adhesions were recognised by the medical attendants as having occurred in the upper part of the left thoracic cavity. He has been troubled occasionally ever since the injury with cough, expectoration, and violent palpitations of the heart. A suspicion has even been entertained that the fistulous canal which remained open a period of eighteen months, and then became permanently closed, communicated with the bronchial tubes, but at no time was a suspicion entertained by him or his medical attendants that the ball was not lodged in the back and there closely encysted.

We are disposed to mention as an evidence of Col. Clayton's loyalty and faithfulness as a soldier that within six months of the receipt of the injury, and while the wound was still discharging pus and blood, he returned to active duty with his regiment and remained in the field until the close of the war.

In the presence of the gentlemen assembled Col. Clayton exposed his chest, and Prof. Bell proceeded to move the coils across that portion of his back where the ball was supposed to be situated, the colonel indicating the point underneath the superior angle of the scapula as that which had been fixed upon by himself and all the surgeons who had examined him as its exact seat. Although being buried underneath the scapula, they had not been able to verify their diagnosis by the sense of touch. Repeated examinations were made over this region without any response both by Prof. Bell and several of the gentlemen who were present.

The instrument was then moved in every direction across the back and shoulders with the same result. There was an evident feeling of disappointment on the part of Prof. Bell and all the gentlemen present, for no one entertained a doubt up to this moment that the situation of the ball was known and correctly stated by Col. Clayton.

It was not until the lapse of half an hour, and a thorough examination on the part of Prof. Bell to determine if there was not some imperfection in the working of the apparatus, that it was suggested to move the instrument along the front of the chest.

This was done by Prof. Bell, and immediately he exclaimed, "I have found it!" And such was evidently the fact, as was verified by the personal examination through the telephone by every gentleman present. The response when the instrument was moved over the seat of the ball was loud and distinct, and left no room for doubt.

After all the visitors present had had the opportunity of verifying my discovery of the sonorous spot on the chest of Colonel Clayton, experiments were made to determine as accurately as possible the exact position of the ball.

The exploring instrument (fig. 23) was first held over that part of the chest where the maximum sound was obtained. The instrument was then moved slowly towards the left, until the sound could no longer be perceived. The position of the centre of the instrument was noted, and a vertical line, A B, fig. 27, was drawn with ink upon the skin through that point. This line indicated the boundary of the sonorous area towards the left. The experiment was then repeated by moving the instrument from the point of maximum sound towards the right, and also upwards and downwards, giving us the four boundary-lines shown in the diagram (fig. 27). The bullet was thus located within a square, C, of about one inch.

The exact situation of the ball, as described in the *Medical Gazette*—

Was found to be within the thorax, probably in immediate contact with the inner surface of the ribs, the point being a little to the left of the sternum, between the third and fourth ribs, and two or three

* See *Medical Gazette*, October 15th, 1881, pp. 347-349.

† The following are the names of the medical gentlemen who were present, each one of whom verified personally the results and declared his entire satisfaction with every experiment that was made: J. C. Hutchinson, J. G. Johnson, and J. G. Allen, of Brooklyn; Elias Marsh, of Patterson, N.J.; Nathan Bozeman, J. H. Hunter, G. Durant, F. Delafield, L. Damainville, W. M. Chamberlain, J. H. Girdner, Frank H. Hamilton, and E. J. Bermingham, of New York.

inches above the cicatrix on the front of the chest, where the sinus, long since closed, had evacuated itself, and in a direct line from this cicatrix towards the left shoulder, which indicated the line of the track of the original sinus.

Experiments with Needles.

During my absence from Washington and from all conveniences for experimenting personally with Induction Balance apparatus, I devised a method of verifying the indications of the Induction Balance and of ascertaining the exact depth at which a bullet lies beneath the surface. This method was communicated through Dr. Woodward to the surgeons in attendance on President Garfield, and it was made the subject of a special paper presented to the French Academy of Sciences November 7th, 1881.

This method, although involving extremely slight pain, would ordinarily be used only as a preliminary to an operation for the extraction of a bullet. The arrangement is shown in fig. 28. A fine needle, A, is connected to one ter-

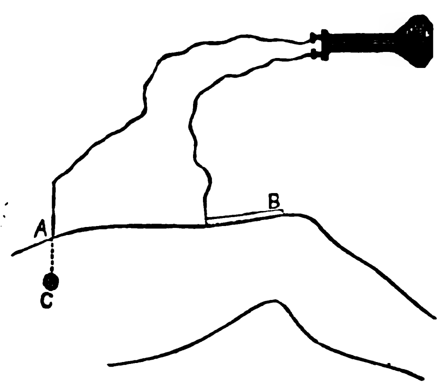

FIG. 28.

minal of a telephone, and the other terminal makes contact with a plate, B, preferably of the same material as that composing the needle. Place this metallic plate, B, against the surface of the patient's skin and thrust the needle into that portion of the body where the bullet is believed to be lodged. When the point of the needle makes contact with the surface of the bullet, C, a galvanic battery will be formed naturally within the body, the two poles of which are respectively the leaden bullet, C, and the metallic plate, B. Under these circumstances a click will be heard from the telephone each time the bullet is touched by the needle. This has been verified by experiments upon bullets buried in a joint of meat. The click, though feeble, is unmistakable.

I have no doubt that this method of exploration alone, without the induction balance, would prove of great service upon a field of battle, where the employment of complicated apparatus is impossible. Mr. Thomas Gleason has recently communicated to me the particulars of an experiment he witnessed, in the course of which this method was tried upon a living subject. The surgeon who conducted the experiment was unable to obtain any response from the induction balance employed, although from certain indications apparent to the sense of touch he believed that the bullet was located in the part of the body submitted to experiment.

To verify his supposition a needle, connected as above (fig. 28), was thrust into contact with the hard substance perceived, but no response was made by the telephone. The surgeon, however, believing that the bullet had been found, etherised his patient and proceeded with an operation, but discovered, when too late, that the bullet was not there.

Further Modifications of Induction Balance.

I sailed for Europe early in October, 1881, and have had no opportunity since of continuing my researches until quite recently. While I was in Europe, however, Mr. Sumner Tainter devised a new kind of Induction Balance which deserves mention here. The results obtained with this apparatus in its present form (fig. 29) are not to be compared with those produced by the best instruments described above, but there are undoubtedly great possibilities of future development.

The important feature is that the exploring instrument, E, consists of *a single coil*, so that there is no possibility of any part of the explorer getting out of adjustment. All the adjustments are made upon the stationary part of the apparatus.

The current of the battery is divided between two equal circuits. One of the primary circuits contains the coil, A, and the exploring coil, E, and the other circuit the coil, C, and a rheostat, R. Coils A and C are exactly similar: and

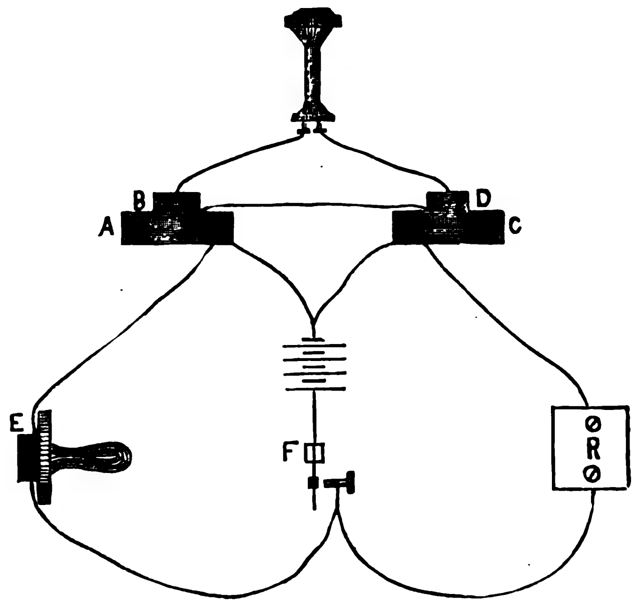

FIG. 29.

if the resistance introduced at R is equal to the resistance of the exploring coil, E, an acoustic balance can be obtained by the adjustment of the secondary coils, B D, upon the primaries, A C; but if the resistance introduced at R is different from that at E, Mr. Tainter states that no balance is possible.

When the apparatus is adjusted to silence the approach of a bullet to the coil E destroys the balance.

Although the great object of the researches that have been brought before you to-day has been to find that arrangement of balance which will detect a bullet at the greatest distance from the coils of the explorer, it must not be forgotten that in every case the instrument is more sensitive to the presence of a bullet placed *inside* the exploring coils than to one exterior to them. When, therefore, we seek the location of a bullet in one of the limbs, it may be advisable to use an annular coil large enough to slip easily over the leg or arm, as the case may be.

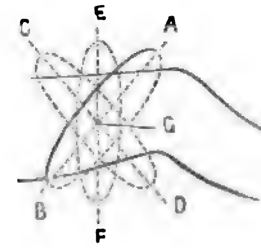

FIG. 30.

In Mr. Tainter's arrangement the exploring coil, E (fig. 29), might simply be a large ring consisting of a number of convolutions of thick wire, which could be slipped over the limb, or the ring might consist of two coils, forming one side of a Hughes Induction Balance.

In either case the loudest sound will be produced when the bullet is in the plane of the ring, and its exact location should be deduced from three observations. Suppose, for instance, that with the ring inclined in a particular direction the maximum sound is obtained when the ring occupies the position, A B (fig. 30). We know then that the bullet is in that plane. Now, incline the ring in some other direction and explore again. Let the position of maximum sound be now C D. We know then that the bullet is somewhere on

the straight line formed by the intersection of the planes, A B and C D. It is only necessary then to make a third observation with the apparatus so inclined that the plane of the ring cuts this straight line, for instance, the position, E F. The point of intersection of the three planes, G, is then the exact point occupied by the bullet.

I shall conclude this paper by the description of an experiment made in Newport, R.I., a few days ago. The results are so unprecedented in my experience that I feel they cannot be received as implicitly reliable until the experiments have been repeated and verified.

I had arranged upon a table three coils (as shown in fig.

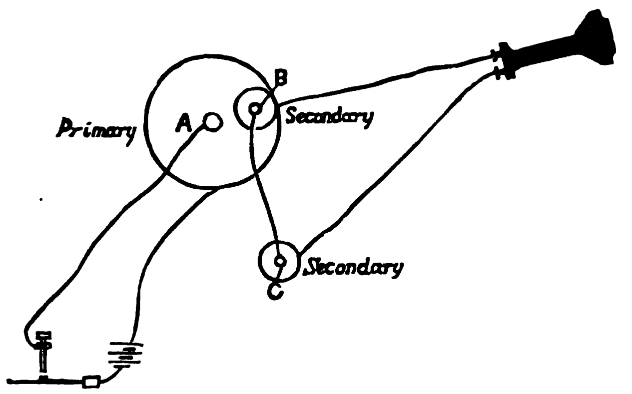

FIG. 31.

31). The large flat primary coil, A, was connected with a battery of four Bunsen elements and an interrupter, as shown, and the two small secondaries of fine wire, B C, were connected with a telephone.

The secondary, B, was moved about on the primary, A, until a position of silence was obtained. Upon bringing a leaden bullet near C the balance was disturbed and a distinct sound produced from the telephone. There is nothing very strange about this when we know that the distance between A and C was only 15 centimetres, so that C was well within the field of induction of A; but what did seem extraordinary was that the approach of the large steel blade of a penknife to the coil, C, produced no effect. The iron diaphragm of a hand telephone brought close up to the coil, C, produced no sensible disturbance of the balance, whereas a small disc of lead produced quite a marked effect. A disc of copper the size of a telephone diaphragm also produced a good effect, but the sound was not sensibly louder than that due to the small leaden disc. A diaphragm of zinc occasioned a feeble but distinct disturbance of the balance. It is unfortunately the case that in all the forms of induction balance described above lead gives the poorest effect of all metals. If people would only make their bullets of silver or iron there would be no difficulty in finding them in any part of the body. In the apparatus shown in fig. 31, however, it seems (unless subsequent experiments should reveal some fallacy) that we have an arrangement which is sensitive to lead and not to iron, or, at all events, which is more markedly influenced by lead than iron.

It is hardly necessary to state that when the coil, C, was removed to a considerable distance from the primary, A, no effect was produced by the approach of metal to the coil, C.

I have in this paper brought before you an outline of a labour of love pursued through many anxious days and sleepless nights. However imperfect or disappointing may be the results so far achieved, they are sufficiently encouraging to enable us to look forward with confidence to the attainment of still greater perfection.

I hope to continue these researches in the future; and certainly no man can have a higher incentive to renewed exertion than the hope of relieving suffering and saving life.

EARTH CURRENTS.—A correspondent, writing from the Orange Free State, informs us that on the 17th November great trouble was experienced on the telegraph circuits through earth currents, which he had never before known so powerful.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I should esteem it a favour if you would insert in your journal a few observations that I feel called upon to make on an article dated December 16th, entitled: "Electrical Engineering Classes." I should not have thought of answering a letter the writer of which had not the courage to sign his name, if I had not found in it a flagrant injustice, directed not only against one of my professors, but against the City and Guilds of London Institute as a whole.

The gentleman who signs himself "One who Wishes to Learn" has not chosen an inappropriate *nom de plume*, for he really has a great deal to learn, since he has not been able to follow Professor Ayrton's clear and interesting course; only, it seems to me that such a pupil is not very competent to form an opinion on the lines followed by one of his professors. However that may be, our zealous student goes still farther; not content with attacking his professor in the most irreverent manner, he proceeds to criticise, with truly inconceivable lightness, the whole organisation of the City and Guilds of London Institute. According to him, the institute is wanting in system, the professors and their assistants in zeal, the laboratory in apparatus and instruments! *O tempora! O mores!* if this were really the case. But fortunately it is not so, and if the writer had tried to deserve the name he assumes he would perhaps have become acquainted with the system and the method observed at the course given at the institute which has *condescended* to receive him.

It would be easy to prove to Mr. X or Y, no matter which, that perfect harmony reigns in the courses given by the professors of the institute; every pupil can, by running through his notes, convince himself of the truth of my assertion; and will feel compelled to acknowledge that all the efforts of his professors are directed to the same practical end. I have travelled somewhat, and have examined attentively numbers of schools and institutes of repute on the continent; I can compare them and form an impartial judgment of their merits, and am not afraid to say, that by its method and practical tendency, and the zeal of its professors and assistants, the City and Guilds of London Institute can vie with the best schools in Europe.

CH. AUG. NUSSBAUM.

ELECTRICAL INSTRUCTION.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—Somewhat to the westward of Wardour Street is a place for the above, as to which an inquiry is made in yours of the 16th December. I know the place well and therefore do not name it.

For practical teaching in electrical engineering I should recommend your subscriber to keep to the eastward of the interesting street I have mentioned.

As one who knew what he was talking about observed recently, "Science is becoming quite an Art," and even though your correspondent's quest be connected with electricity, you will, I believe, agree with me that he cannot be advised to forget the old maxim,

CAVEAT EMPTOR.

ELECTRO-MOTORS.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—As Mr. Moritz Immisch has obviously not quite grasped the meaning of several points in my recent lecture at the Society of Arts I am sorry that he has not waited for the appearance of the printed lecture in the Society's Journal before ventilating his difficulties, some of which would, I think, have disappeared on further consideration. Pending the publication of the full text in the Society's Journal I would rather be excused from entering upon the many points raised by Mr. Immisch. But as one of them is somewhat outside the range of my lecture I may perhaps deal with it.

I think Mr. Immisch makes the mistake of confounding together the efficiency of a motor *per se* (*i.e.* the ratio of the mechanical power it performs to the electrical power it absorbs) with the efficiency of a system for transmitting power by electricity, which system includes a generator at one end of the line and a motor at the other. Now, suppose that at each end of such a line we place a dynamo of very perfect construction, such, for example, that each would have in itself an *efficiency* of 90 per cent.

If everything is arranged in the best possible manner then the greatest possible theoretical efficiency of the combination is 81 per cent. For the generator will turn 90 per cent. of the mechanical power into electrical power, and 90 per cent. of the electrical power so transmitted will be reconverted by the motor into mechanical power. Now the point at which Mr. Immisch stumbles is, that the efficiency of a system never attains this theoretical value (namely, the product of the separate efficiencies of the two machines) unless the motor runs at so high a speed as to annul the current sent from the generator. He does not seem to comprehend that efficiency is a *ratio*, not a concrete quantity, and that this ratio has its highest theoretical value when both the concrete quantities composing it have indefinitely small values. But let him reflect that if there is a strong current running through the system there will be heat waste; which necessarily implies that the whole of the electric power is *not* being converted into mechanical power by the motor. Again, it must be quite evident that the efficiency of a system is different from that of the motor *per se*. Suppose the dynamo used as generator to be a small one of 90 per cent. efficiency and high electromotive force, but suitable only for working up to, say, one horse-power. Let the machine used as a motor be, let us say, a heavy electroplating dynamo, also of 90 per cent. efficiency and of 10 horse-piower. Will any one who knows anything about dynamos or motors suppose that such a system can by any possibality work with an efficiency of 81 per cent.? On the contrary it will be about as inefficient as could be contrived. My lecture gave the reason why in the very theory which Mr. Immisch disputes.

I must therefore ask Mr. Immisch whether, when he has confused the efficiency of a single machine with the efficiency of a system working together, he is quite in place in attempting to discredit the suggestions relative to the construction of motors thrown out in my lecture. "It seems to me unlikely," says Mr. Immisch, "that rules and standards for comparing relative merits of motors can be constructed upon foundations such as this." It would have been better if Mr. Immisch had not mixed up rules and standards for comparing the relative merits of motors with the rules and theories for comparing the relative merits of systems. I do not mind his discrediting my motor, and saying it is inefficient: for I can prove him wrong, if he is wrong. I do not mind his discrediting my theory of transmission of power by a system, because my theory is not mine, but is simply mathematical reasoning, capable of being experimentally proved. But I do object to Mr. Immisch saying, in effect, that because he can't comprehend my theory of transmission of power by a system, that therefore my rules and standards for the merits of motors are not to be trusted.

Lastly, I will put one point to Mr. Immisch. He says that when the motor was allowed to run "the current itself, as measured by a current-meter," was "necessarily falling off." Now, a falling-off in the current could only arise from one of two causes, either from an increase in the resistance of the motor, or from an opposing electromotive force in the motor itself. Which does Mr. Immisch suppose it to be? He surely ought to have made the tests necessary to convince himself which it is, in the case of his own motor, before he rushes into print with criticisms on the theory of motors in general.

I am, dear Sirs, yours faithfully,

SILVANUS P. THOMPSON.

[This letter from Prof. Thompson renders it quite unnecessary that we should reply to Mr. Immisch.—EDS. ELEC. REV.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—In perusing your interesting report of the Proceedings of the Society of Telegraph Engineers and of Electricians I was somewhat disappointed to find that the question of supplying provincial members of the society with books from the library had again passed unnoticed.

As we are shortly to have the Parcels Post in operation, it cannot surely be difficult to arrange for those who do not reside in London enjoying the advantages of so valuable a library. The books might be sent direct to the applicant, or in the case of large towns where there are many members, let one be appointed to act as local secretary, to whom all applications for books should be addressed, and through whom all books should be issued and returned.

The few pence incurred for transmission would be ungrudgingly paid, and the society would gain by an increased membership, a larger sale of catalogues, and by the deepened interest of its members.

Thanking you in prospective for the insertion of this note in your excellent journal,

I am, yours truly,
FAREHAM.

THE INSTITUTE OF PATENT AGENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—In your article on the Institute of Patent Agents you speak of the names of the Fellows being a guarantee of efficiency. But is it not, to say the least, surprising that a body of gentlemen who are to sit in judgment upon the qualifications of others should not have been called upon to give some more substantial proof of their own qualifications? Might not the excluded (or "non-included") members of the profession reasonably ask, in the language of Scripture, "Who made ye to be judges and rulers over us?"

I am, Sirs, your obedient servant,

ONE OF THE NON-INCLUDED.

London, *December 27th.*

ELECTRICITY AS A POWER TRANSMITTER.—From Glasgow we learn that some months ago Mr. Joseph Atkinson, an *employé* of Messrs. Denny, Dumbarton, while engaged fitting zinc sheathing to the shell of the s.s. *Shark* by his patented process, used a Siemens D 7 generator, driven by an ordinary donkey-engine. Through a distance of 150 yards a power equivalent to 6 horse-power was transmitted to a motor near the vessel's side, enabling the work to be expeditiously and economically carried out. The process is, of course, available at any time.

NOTES.

Electric Lighting.—The Lord Provost of Edinburgh, in moving the adoption of a recommendation to the effect that the resolution of the special meeting of 14th November last to apply for a Provisional Order under the Electric Lighting Act, 1882, should not be acted upon, stated the reasons why the committee appointed had departed from their previous resolution. He said that at that time, as they would remember, there were notices of applications for Provisional Orders from no less than seven different companies. There was now only a notice from one, consequently they had no longer to fear their streets would be broken up by a great many companies, and they would only have this company to treat. In the next place, a very important meeting took place between Mr. Chamberlain, as representing the Board of Trade, and deputations from nearly all the corporations in England and Scotland. There they learned most distinctly that no permissive order would be acceptable to the Government—that the Electric Act was specially passed for the purpose of encouraging science—and it would not be permitted that any bogus order should be brought forward simply to test what the electric light could do. The matter was remitted to the Lord Provost's Committee, with powers.

The Jarrow Town Council, after some discussion, recently came to the conclusion that it was not advisable for them to apply for a licence to supply the electric light just at present.

We hear that the recent installations of the electric light on Tyne side are giving much satisfaction and that preparations are now being made for several important extensions.

The Bootle Town Council, to "avoid the hasty adoption of a defective system of electric light," are to oppose the applications of the Hammond, Gülcher, and Swan companies for Provisional Orders.

On Friday, the 15th inst., the Gülcher electric light was exhibited in Scotland for the first time. The warehouses of Messrs. P. & W. M'Lellan, engineers, Trongate, Glasgow, were lighted by five arc lamps and a series of incandescence lamps. The warehouses were visited by a large number of merchants, shipbuilders, and other business men, all of whom expressed themselves well pleased with the installation.

The local press of Dundee say that in the midst of many failures or very partial successes, the electric lighting of the Fine Art Exhibition has been a marked success. Mr. Macwhirter, A.R.A., the eminent landscape painter, on the occasion of his recent visit to Dundee, spoke in terms of approbation of the light, which he considered superior in steadiness and purity of colour to the electric light in the Royal Academy last winter.

The Dundee Gas Commissioners have decided to lodge an application for a Provisional Order.

The minutes of the Glasgow Watching and Lighting Committees, dated December 15th, contain a letter from the manager of the Brush Electric Light Company in regard to street lighting by electricity, and proposing that the Glasgow municipal authorities should adopt the same plan as Dundee and Aberdeen. In these two towns the company have agreed to run a sufficient number of lamps to light the streets at so much per lamp per hour, in order that their system may be fairly tested, and be free from all expenses therewith beyond the sum per lamp agreed upon, and the usual assistance. The letter was reserved for future consideration.

The new Royalty Theatre, to accommodate two thousand persons, and lighted with the Brush electric light, was to have been opened at Chester on Saturday night, but at the last moment it was discovered that the mechanical stage would not work, and several hundred persons had to be turned away. The electric light was tested, and was found to be a great success. The theatre was opened on Tuesday with the pantomime of *Aladdin and his Wonderful Lamp.*

On the 20th inst. Messrs. Bell Brothers, Newcastle-on-Tyne, introduced the electric light for the illumination of their overground and underground works at South Brancepeth Colliery. The system selected was the Maxim-Weston. Nine lamps are on the pit-heap and in the engine-house, and twenty-four underground—seventeen being in one pit, and light the shaft, bottom, sidings, stables, and engine-house. A double engine with a pair of 10-inch cylinders with 20-inch stroke, at a speed of 90 revolutions per minute, which gave 800 revolutions on the dynamo, was used. A second engine is in a forward state, and will shortly be ready for work, when the whole of the surface-works, colliery offices, manager's and engineer's houses, &c., will be lighted by electricity. The engines for working the dynamos are driven by steam got from the waste heat of the coke-ovens, which are close by.

Last week the Jablochkoff electric light was used to enable the workmen to proceed without stopping with the building of the Hôtel Métropole, in Northumberland Avenue. A successful installation of this system of lighting has just been completed at Lindal Moor Mines, Ulverston, for Messrs. Harrison & Co. Sir Henry Vivian has sent the company information of its successful introduction to his mines in Norway.

On Saturday last the electric light was shown for the first time in the streets of Aberdeen. The start does not appear to have been quite satisfactory, but the moon was saddled with the blame. On Monday, however, the light on the streets was very much improved, while the lighting of the Industrial and Art Exhibition called forth the praises of all who visited the exhibition. The local contemporary, speaking of it, says, "The great contrast between the electric light and the gas in the adjoining hall was at once apparent. There can be no doubt that, so far as the interior lighting of the large spaces was concerned, there was no comparison between the two."

In the First Division of the Court of Session, Edinburgh, on the 15th inst., Mr. Alison presented a petition for the New Glenduffhill Coal Company, No. 58, West Regent Street, Glasgow, asking that the Universal Electric Company, No. 4, Baltic Street, Bridgeton, Glasgow, be wound-up, and that interdict be granted against the sale of the company's effects. The respondent's company is now insolvent, and two of its creditors have already obtained decrees against it, and have advertised a sale of its effects. Their lordships granted interim interdict, and ordered the petition to be intimated to the respondents. The Universal Electric Company was incorporated in December, 1881. It was established to purchase patents for the improvement of electric lamps and apparatus used in making them, and also improvements in dynamo-electric machines. The capital of the company was originally £20,000, in 8,000 shares of £5 each. It was subsequently increased to a nominal capital of £250,000, but no part of the increase has been issued.

On Thursday evening, 7th instant, a highly interesting and instructive lecture on "Electric Lighting" was delivered at the Town Hall, Brecon, by W. S. Rawson, Esq., M.A. (late of Christ College, Brecon), who is now with the firm of Messrs. Woodhouse and Rawson, electrical engineers, 11, Queen Victoria Street, London.

The Yorkshire Brush Electric Light and Power Company (Limited), Leeds, is lighting the Dewsbury Theatre by means of arc lamps: one lamp is erected at the front of the building, one in the auditorium, and one focussing light on the front of the stage. At present the effect is very good for scenic purposes and the managers are quite satisfied with the result. The company are now fixing two more lamps at the wings on either side of the stage in order to counteract the shadows cast by the ballet girls from the intense light of the focussing lamp. The dynamo-electric machine is driven by a small cylinder engine in a turning shop adjoining. This is the first theatre in England lighted with arc lamps. The installation is under the supervision of Mr. A. Gay, one of the company's electricians.

The Dover Town Council have decided to abandon their application for powers to supply electricity for lighting and other purposes.

At a recent meeting of the lighting committee of the Dundee Police Commissioners an offer was submitted by the representative of the Brush Electric Light Company (Scotland) to maintain 16 2,000 candle-power arc lamps, the lamps to burn from sunset till daylight, for six months, at

the rate of 1½d. per lamp per hour, on condition that the commissioners erected suitable lamp-posts and supplied engine power for the dynamo. If the company gave the engine power then the rate would be 3d. per lamp per hour. The sub-committee appointed to consider this proposal report that the terms proposed amount to three times the sum required to light the same area by gas. The offer has been rejected and the committee instructed to consider the matter further and again report.

At Drewsbury the market place was effectively illuminated by the electric light last week. A number of elegant designs were shown to great advantage.

Electric Light in India.—The opening of the Sirhind Canal at Rupar on the Sutlej, by H.E. the Viceroy of India, afforded to the Eastern Electric Light and Power Company an opportunity of displaying an installation, consisting of both Arc and Incandescence lighting, such as has never been seen in India. The camps of the Viceroy, the Lieut. Governor of the Punjab, the Civil and Military, and the Native Chiefs were brilliantly illuminated by 48 Brush Arc lamps of 2,000 candle-power each, from the 22nd until the 26th November, and the reception and dining tents of the Viceroy were lighted by 36 Lane-Fox Incandescence lamps of 20 candle-power, causing intense astonishment in the minds of the many thousand natives who crowded nightly round the engines and dynamos employed in the working—so much so that police had to be employed to keep them back. On the night of the 24th the current used for the lighting of the Incandescence lamps was transmitted to lamps lighting the Railway Station for the departure of H.E. the Viceroy. As soon as his train left the current was returned to his camp. The necessary power was supplied by three 16-light Brush Dynamos, driven by portable engines.

Transmission of Power by Electricity.—At the works of the Railway and Electric Appliances Company, Polmadie, Scotland, the first practical application of the transmission of power to a distance in every-day use in Scotland has been made by Mr. Rankin Kennedy. By means of two dynamo-electric machines, designed and made by him at the above works, a power of from four to five horse is transmitted from the line shafting of the turning and fitting shop of the works through two small copper wires to the department occupied by the carpenters and pattern-makers on the opposite side of the yard of the works. The power thus transmitted is used by the carpenters and pattern-makers for driving the large saws cutting their wood, and is completely under their control. By means of a simple handle or lever a man can start a saw, cut his wood, and then stop the saw again, just as simply as if he had a small engine with steam laid on ready to start when wanted. In fact, the power is only expended when wanted. In this example of electrical transmission of power two of Kennedy's patent dynamos are used. One, the generator which supplies the current, is seated on the floor of the turning shop of the works, and is driven by a belt from the line shaft which drives all the machinery of the works. This generating machine runs all day, and from it two copper wires are led away to the carpenters' and pattern-makers' shop, which wires are fixed and connect to the other Kennedy's patent dynamo, which is seated on the floor of the carpenters' and pattern-makers' shop. This second dynamo machine receives the current from the first, and its shaft revolves at a speed of 600 revolutions per minute, and a belt from the pulley on this shaft drives the saws when the circuit is closed by the switch. Logs of wood seven inches thick can easily be cut up by the circular saw driven in this way. Mr. W. B. Brain, one of the proprietors of the Trafalgar Collieries, Forest of Dean, who for a long time past has been much interested in the application of electricity as a motive power, has lately had erected at his colliery a pump driven by electricity. In this case the pump is placed underground, and is employed for pumping the water that accumulates in the deep workings to the bottom of the pit. An electric motor is used for driving the pump, the motor being connected with a dynamo machine placed on the surface. The pump, which is of the ordinary plunger form, has a lift of some 115 feet, and has to force the water through about 500 yards of pipe to the bottom of the shaft, whence the water is raised by the ordinary steam pumps. The quantity of water thus raised is 2,400 gallons per hour. The result of this application has proved most satisfactory, and Mr. Brain proposes to still further extend the system of electrical transmission of power. The electrical arrangements were intrusted to the Pyramid Electric Company, and were carried out under the supervision of the managing director, A. Le Neve Foster, Esq.

The Telephone in Scotland.—The Aberdeen Town Council are, in future, to include a charge of 10s. in the statement of Fire Attendance Expenses in respect of the telephone connections which have been provided by the Council between the residences of certain members of the fire brigade and the police officer. The number of fires per annum is given as 30, and the telephone connections cost about £1 a fire. The Insurance Companies are to pay the second half of the £.

From a popular lecture on "The Telephone," delivered by Mr. Ross, the National Telephone Company's Manager, on Saturday, the 16th inst., at Aberdeen, it appears that there are already 100 subscribers to the Exchange, and applications for nearly as many more are waiting acceptance.

The telephone is being rapidly extended in Dundee; both Companies registering from 9 to 16 new subscribers weekly.

From Edinburgh and Glasgow good progress is reported.

Winter Electric Exhibition, Royal Aquarium, Westminster.—The engineer to the Exhibition, Mr. Will. D. Gooch, informs us that it is shortly to be opened. Motive-power to the amount of nearly 500 horse-power has been arranged for by the direction of the Aquarium, in the buildings specially erected as machine annexes. The body of the hall will be devoted to arc lighting, which will be represented by 14 or 15 systems, several being new. The space underneath the galleries and the galleries themselves are subdivided into courts for the purpose of exhibiting the several systems of incandescence lighting and fittings applicable to it. The ground floor of the whole of the building and parts of the galleries are apportioned out to exhibitors for the purpose of displaying the different accessories of electrical application, the most notable feature of which will be the motors, 14 in number, which will drive machinery. The dining annexe will be lighted by Messrs. Ferranti, Thompson & Ince, with 350 incandescent lights, actuated by one of their new machines. There are five courts fitted up for the display of the Edison electric light and the different features of the Edison system. All the remaining courts are occupied by other firms to illustrate either new incandescence lamps or fittings for their use. Thus the whole of the premises of the Aquarium will be occupied for the exhibition, which will very fairly represent all the present systems of lighting and transmission of motive-power by electricity.

The Metropolitan Brush Company have contracted to light up the Imperial Theatre during the course of the exhibition, and we understand that their installation will be ready by January 6th. The exhibition is easily accessible, and should not fail to prove of great interest.

A Royal Subscriber to the Telephone Exchange.—Ajuda Palace, the town residence of His Majesty Don Luiz I., King of Portugal, was early this month connected to the public telephone exchange in Lisbon, Don Luiz thus being the first European monarch who has had a telephone line to a public exchange. The majority of the ministers are already connected to the exchange from their respective *Gabinetes*, as well as the Civil Governor, General Commander of the Military Division, Municipality, and the Commander of the Municipal Guard, to which last His Majesty first spoke, in order to try the telephone, with which he expressed his complete satisfaction and surprise, as "the voice of the general seemed to come from inside the case," as also with the elegant appearance of the instruments, which consist of a Gower-Bell and magneto call mounted on a backboard, the whole being specially got up in black and gold by the Telephone Construction and Maintenance Company. His Majesty honoured Mr. H. S. Samuel, the manager of the company, and Mr. A. Danvers, the company's engineer, with an interview on the occasion, during which the telephone and the way it is used were explained to him.

NEW PATENTS—1882.

5961. "Dynamo or magneto-electric machines." G. L. ANDERS and J. B. HENCKE. Dated December 13.

5977. "Galvanic batteries." J. RAPIEFF. Dated December 14.

6002. "Apparatus for lighting interiors by electricity and other illuminating agents." A. M. CLARK. (Communicated by G. Trouvé.) Dated December 15.

6003. "Electrical conductors, couplings, switches, and terminal connections." S. H. EMMENS. Dated December 15.

6004. "Electrical installation fittings." S. H. EMMENS and R. I. BARNES. Dated December 15.

6019. "Dynamo-electric machines." W. S. HOBBY. Dated December 16.

6020. "Telephonic apparatus." G. L. ANDERS and J. B. HENCKE. Dated December 16.

6023. "Telephonic apparatus." W. R. LAKE. (Communicated by G. M. Torrence.) Dated December 16.

6046. "Electric lamps or lighting apparatus." H. H. LAKE. (Communicated by J. Kremenezky.) Dated December 18.

6067. "Electrical gas lighting apparatus." S. E. PATTISON. (Communicated by W. A. Drysdale and C. W. Bailey.) Dated December 19.

6075. "Incandescent electric lamps." L. A. GROTH. (Communicated by A. Bernstein.) Dated December 20.

6083. "Electro-motors or machines for generating electricity." L. MILNE and L. B. MILLER. Dated December 20.

6085. Telephonic apparatus." W. R. LAKE. (Communicated by M. F. Tyler.) Dated December 20. (*Complete.*)

6102. "Insulator for telegraphic and like wires." A. G. BESSOMAIER. Dated December 21.

6105. "Electric meters." F. H. VARLEY and J. R. SHEARER. Dated December 21.

6118. "Construction of the receptacles or vessels of secondary batteries." G. BINSWANGER. Dated December 22.

6146. "Dynamo-electric, magneto-electric, or electro-dynamic machines." R. MATTHEWS. Dated December 23.

6150. "Automatic electric signalling apparatus for railways, also applicable to other purposes." H. J. HADDAN. (Communicated by H. Fortin and J. J. Langlet.) Dated December 23.

6153. "Electric and other lamps." J. M. FLETCHER. Dated December 23.

6164. "Apparatus for the production of the electric light." A. M. CLARK. (Communicated by L. Gérard and W. V. Bonsor. Dated December 23.

6183. "Electrical generators and motors." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated December 27.

6185. "An improved electric arc lamp." A. M. CLARK. (Communicated by Solignac et Cie.) Dated December 27.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1896. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated April 20. 6d. This invention has for its object improvements in telephonic and telegraphic signalling apparatus. The purpose of this invention is to enable a number of stations connected by one line-wire to communicate under such conditions that any station can speak to any other, the remaining stations meanwhile being prevented from overhearing or interrupting.

1901. "Voltaic batteries." A. R. BENNETT. Dated April 21. 4d. This invention has for its object the production of an improved cheap and effective voltaic battery, and is a further development of the invention for which letters patents have been granted to the said A. R. Bennett, No. 302, 1882. To form the negative portion of this improved battery, the inventor uses an electrode of iron, steel, copper, gold, silver, nickel, cobalt, or any of the platinum group of metals, the shape of which is immaterial, with or without a packing of fragments of the same metal placed in, or containing, a solution of potassium monoxide, potassium hydroxide, sodium monoxide, or sodium hydroxide. These monoxides or hydroxides may be used separately, or they may be mixed. The inventor also uses a solution of permanganate of potassium mixed with one or more of the foregoing solutions, excepting those of sodium monoxide or sodium hydroxide.

1915. "Electric lamps." W. T. WHITEMAN. (A communication from abroad by Messieurs M. Bauer and Company of Paris.) Dated April 22. 6d. This invention consists partly of improvements on an invention for which letters patent, No. 2038, dated 10th May, 1881, were granted to H. J. Haddan, and the said improvements consist firstly in using a horseshoe electro-magnet for actuating and controlling the motion of the carbons in electric arc lamps, the said magnet being so mounted in the lamp as to be capable of vibrating or turning on pivots or axes formed at the ends of the bar by which the two limbs of the magnet are connected. The said two limbs of the magnet are of unequal length, and the pole of the longer limb is curved with a radial curve, the centre of which is the axis on which the magnet turns. The said magnet is so mounted in the lamp that the pole of its shorter limb bears against the iron rod carrying the upper carbon. The said improvements consist further in forming the pole of the shorter limb of the magnet which bears against the rod carrying the upper carbon, as hereinater described.

1919. "Electric arc lamps." J. LEA. Dated April 22. 6d. Has for its object the better regulation of the feed of the carbon or carbons, in order to insure a steady light; and at the same time to be able to employ carbons of greater length than heretofore. According to the invention, the upper carbon is held in position by rollers (by preference, three), two of which are held in a metal frame for their bearings, while the third is a riding or "jockey" roller, adjustable to any given pressure by means of a spring and adjusting screw. These rollers are so constructed as to allow of different sized carbons being placed between them. The feeding action for lowering the upper carbon, as consumed, is as follows: A solenoid or an electro-magnet is employed and actuates a gripping lever for the purpose of revolving the rollers, and this solenoid, or electro-magnet is connected as a shunt from the main circuit. This shunt circuit is divided to allow of a variable resistancein order to increase or decrease the motion of the feeding lever. A second solenoid or electro-magnet is employed to form the arc by separating the upper and lower carbons. A projecting arm is placed upon the frame of the jockey roller in such a position that, should the carbons be apart, the feeding solenoid or electro-magnet acts upon and releases the jockey roller, and allows the carbons to come into contact. A short-circuiting arrangement is placed upon the frame of the jockey roller, so that when the upper carbon is consumed, a contact is made, and the lamp cut out, but allowing all the other lamps in the same circuit to continue burning.

1940. "Electric batteries." W. R. LAKE. (A communication from abroad by Louis Maiche, of Paris.) Dated April 24. 6d. Relates to the battery described in the number of the Review for April 15th, 1882.

1945. "Telephone alarms." W. M. BROWN. (A communication from abroad by J. F. Kettell, of America.) Dated April 25. 8d. Relates to the apparatus described in the number of the ELECTRICAL REVIEW for July 15th, 1882.

1946. "Secondary batteries." C. V. BOYS. Dated April 25. 6d. Relates to improvements in the construction of secondary batteries whereby a considerable economy of time may be effected in the operation of "forming" such batteries, whilst at the same time better results are obtained. According to the invention, in lieu of coating the lead plates of secondary batteries with oxides or salts of lead, the inventor coats metallic plates or other supports with a layer of finely-divided lead produced in the manner next hereinafter described. For this purpose he melts lead and pours it into a box or suitable receptacle in which it may be gently moved until it begins to granulate. He then causes the box to be violently shaken, by machinery or otherwise, so that the lead is thrown in all directions in the box and reduced to a fine powder. When sufficiently cool, the powder is removed and sifted from larger particles. This lead dust may then be shaken up with a weak solution of mercury and washed with water. It is then spread in layers on metallic plates or other supports, and compressed sufficiently to make it bind together. The plates are then arranged so that they may lie in a weak acid solution; or, in lieu of spreading the lead dust on plates or supports as before mentioned, it may be consolidated so as to render an artificial support unnecessary, the electrodes so prepared being used in a weak acid solution as before.

2037. "Manufacture of electric incandescent lights in the vacuum." A. L. JOUSSELIN. Dated April 29. 2d. Relates to the manufacture of incandescent lamps, and consists in, first, the means of constructing the transparent shell and insulating the conductors; second, the treatment of the materials from which the incandescing carbons are made; third, the manufacture of the incandescing carbons; and fourth, the attachment of the carbons to the conductors. (*Provisional only.*)

2092. "Electric light apparatus." C. LEVER. Dated May 3. 8d. The first part of this invention has for its object improvements in electric lamps where the light results from the electric current passing between points or pencils of carbon. The way the inventor accomplishes this part of the invention is preferably by commencing in an inverse manner to that usually employed in electric arc lamps, *i.e.*, the carbon electrodes in the lamp do not make contact with each other before the electric current is sent through the lamp. Instead of employing an electro-magnet or solenoid in the main circuit to separate the carbon points for the production of the voltaic arc as is usually the case, the inventor employs an armature lever in combination with a spring, weight, gaseous or fluid pressure to separate the carbon points to the required distance for the display of the voltaic arc, this distance being regulated by means of a set screw acting on the said armature lever and limiting its movement. Acting on the opposite end of this armature lever, and in an opposite direction to the spring weight, gaseous or fluid pressure is an electro-magnet in a shunt circuit of a considerably greater resistance than that of the arc from which it is shunted or derived. The armature lever is free to move on a pivot or fulcrum pin fixed to the casting, preferably of brass or other diamagnetic metal—in which are enclosed the shunt electro-magnet and clip or other device by which the said armature lever can raise the upper carbon holder—which slides through the said casting—by means of the said spring, weight, gaseous or fluid pressure.

2125. "Producing electric currents." K. PARZELSKI. Dated May 5. 2d. For the purposes of invention the inventor digs a pit or hole so deep as to be at its bottom perpetually covered with water. Into it he places zinc in any quantity, large or small, according to the force to be produced. Then by the side of the zinc, or at any distance, even though thousands of miles from it, but also in a pit or hole like that just described, are placed one or more pieces or plates of some other metal, or, still better, some mineral containing large quantities of carbon, for instance, coal, coke or graphite. After having then connected the zinc with the other mineral, by means of a good conductor, for instance an iron wire, the inventor obtains a

vigorous galvanic current. This current has, moreover, the property that its conductor does not require isolation, and can therefore be placed without any isolating envelope in the ground and even in water ! ! ! ! ! (*Provisional only.*)

2128. "Regulating and utilising electric currents." W. ARTHUR. Dated May 5. 6d. The object of the invention is so to affect a subdivision of the electric current used for lighting electric lamps or other purposes, that the resistance shall remain the same whether the current is turned on to the electric lamp or otherwise, whilst at the same time there is no loss of power whilst the current is not being utilised. To attain this object, the inventor breaks up the main cable at two stations, say, at different ends of a street, into a number of smaller cables or wires, equal to the number of lamps required between the stations, and each wire is connected and balanced so that the resistance may be equal. At the lamp the current when not in use passes through an accumulator, or some other resistance, equal to the resistance of the electric lamp, and the wires are so arranged that when the current is turned on to the electric lamp,or used for other purposes, the accumulator or resistance is cut out.

2135. "Forming lead for secondary batteries, &c." T. CUTTRISS. (Partly a communication from abroad by C. Cuttriss, of America.) Dated May 6. 4d. Relates to a process of forming or preparing lead in the shape of plates, or otherwise, for secondary batteries or magazines of electricity, by means of combinations in suitable proportions of sulphuric acid, nitric acid, and chromic acid, and an electric current; also to an improvement in the construction of batteries whereby a more enduring battery is obtained.

2136. "Incandescent lamps." J. RAPIEFF. Dated May 6. 4d. This invention consists of improvements in the construction of electric lamps made with carbon filaments or strips, by the carbonisation of suitable organic substances cut before or afterwards in proper shape or form, and the deposition upon them of pure carbon from carboniferous liquids, gases or vapours, by electricity, or heat, or both. Besides the ordinary means, the carbon filament may be made by the carbonisation of organic substances such as collodion prepared from gun-cotton flux, &c., and deposited from the solution by suitable means in the shape of sheets, plates, or ribands or threads, after which upon this may be deposited carbon in a pure state from liquid gases or vapours. Under the names of carboniferous gases or vapours the inventor uses gasoline, benzine, chloroform, &c., but of more importance, gases or vapours obtained from liquids not containing hydrogen, such as chemical compounds of carbon with chlorine and bromine, sulphur and iodine, separate or together, or a mixture of these or any other substances similar in natures. To obtain the carbon filament by this deposition of the pure carbon thereon from the above-named gases or vapours, not only of equal resistance but also of the same fineness of the grains of deposited carbon, the inventor uses an improved automatic arrangement. The volume or fineness of the grains of the deposited carbon on the said filament depends upon the temperature to which it is heated (by the passing of the current through it), providing this temperature is high enough to decompose the surrounding carboniferous medium. (This process may be called the treatment of the filament.) It is obvious therefore that if the temperature of the filament remains the same or changes regularly the same fineness of the carbon deposit will result. To obtain this necessary result the inventor divides the electrical current into as many branches as possible, according to its strength and the requirements, and inserts in each of these branches the filament to be treated and an automatic electrical or magneto-electrical arrangement which will come into play when the filament has acquired the proper resistance, will cut off the heating current from it and at the same time substitute in the circuit a resistance equal to that of the completed filament; it is evident that the current in the other branches where the other filaments are in the course of treatment will not be affected. For the more effectual sealing of the conductors the inventor forms the lower part of the bulb, or case into a tube, cylindrical and slightly conical; after the introduction of the carbon filament clamps and conductors into the bulb, he takes a glass thimble or cup of such a size as may be conveniently introduced into this tube, leaving the annular space for the conductors as small as possible. To complete the sealing and to produce uniformity in the size of the finished lamps, the inventor heats to the necessary degree the said tubular part of the lamps and thimble, and after introducing into the latter a suitable core or tool, he squeezes the whole together to form the desired shape.

2138. "Apparatus for producing electric currents, &c." A. MILLAR. Dated May 6. 2d. Relates to improvements in apparatus for producing electric currents, and which may also be employed for obtaining motive-power. The improvements consist in employing, for the purpose of producing electric currents, an electro-magnet, or a permanent magnet, so constructed that each of the two poles of the magnet forms circles concentric with, or disposed symmetrically to each other, so that the space which separates the two circles is also circular. (*Provisional only.*)

2144. "Electric lamps." J. H. JOHNSON. (A communication from abroad by J. M. A. Gérard-Lescuyer, of Paris.) Dated May 6. 6d. Relates to electric lamps and consists of a peculiar method of arranging and supporting the carbons or candles.

2186. "Incandescent electrical lamps." H. LEA. Dated May 9. 6d. Has for its object to facilitate the connecting and disconnecting of incandescent electrical lamps to and from the brackets and supports carrying them and simultaneously connecting and disconnecting the carbon filament of the lamp with the electrical conductors by which electricity is supplied to the lamp.

2184. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 9. 2d. A hollow iron cylinder, free to move, has another cylinder inside it. They are united together or worked out of the solid. This compound cylinder is mounted so as to rotate upon its axis. Magnetism is imparted to it by an arrangement of magnets or a hollow helix surrounding it, so that the double cylinder forms one of the poles of the magnet. In between these two cylinders is placed another magnetic cylinder which may be stationary or made to rotate. This cylinder is wrapped with wire parallel to its axis. This cylinder forms the other pole of the magnet. (*Provisional only.*)

2185. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 9. 2d. This invention is designed for the production of rotary motion from electric currents or electric currents from rotary motion, and for getting rid of or greatly reducing the burning at the places of contact. Where the word magnet is used in this specification it is to be understood that any magnetisable metal is meant. The magnets are sometimes permanent, sometimes electro-magnets according to circumstances. The first method of carrying out this invention consists of placing two or more magnet bars end to end free to rotate axially in either direction. Near to or surrounding each bar is placed the hollow pole of a magnet. Each alternate bar may be a fixture. On passing a current through the bars rotation is produced. These rotating bars are connected by gearing or otherwise with the apparatus to be moved. If the bars are rotated a current of electricity is generated. The second method of carrying this invention into operation consists of a long magnet bar having magnet discs upon it. The discs have near them or around them a magnet ring, and the bar in between the discs passes through a hole in a magnet, or a magnet or magnets are brought near to it. If the north poles of the magnets be presented to the discs the south poles of the magnets are presented to the bar between the discs. On passing an electric current through the bar from end to end rotation is produced. The discs may in some cases be insulated from the iron bar and have spring rubbers connecting the circumference of the disc with a point near the centre of each disc. When the bar is rotated currents of electricity flow between the centre and circumference of the disc. For the convenience of constructing this machine each alternate magnet has a disc screwed into it. This disc has a hole through which the bar passes; in order to put this disc over the bar it is made in two halves and pinned together so that when put together and screwed inside the pole of the fixed magnet it acts as a portion of it. (*Provisional only.*)

2207. "Electro-magnetic and magneto-electric engines." C. F. VARLEY. Dated May 10. 2d. This invention may be constructed with one moving spindle, but two or any multiple of two spindles are preferred. The object is to get a conductor moving between the poles of magnets so as to generate currents of electricity. A description of the apparatus with four parallel spindles will illustrate other combinations. On the further end of the left-hand spindle is placed an insulated conducting disc. On the rest of that spindle are placed insulated conducting reels. On the intermediate spindles are placed insulated discs. On the right-hand spindle are placed insulated reels, and at its near end an insulated disc. These discs and reels are either geared together by teeth cut in their peripheries, or are made to overlap each other and touch, or nearly so, or they may rotate between fixed pieces of conducting materials curved so as to fit portions of the peripheries. When combined, they form a continuous conductor from left to right, back from right to left, and so on. These discs are slotted from the circumference towards the centre to prevent false conduction. These slots may be filled with non-conducting material, such as vulcanite. In order to make the resistance at the junctions as small as possible, jets of fluid metal (such as mercury) are made to play upon them, or the discs may dip into trays of fluid metal to effect the same purpose. In between these discs are placed poles of magnets, so that the rotating discs cut the magnetic rays and produce one continuous current from one end of the machine to the other. (*Provisional only.*)

2225. "Dynamo-electric machine." T. FLOYD and T. KIRKLAND. Dated May 11. 2d. It is proposed to make the field magnets themselves revolve, and in a direction opposite to that of the armature, so that if both were being driven at a speed, say, of 1,000 revolutions per minute, the speed with which the lines of force were being cut would be the same as if the field magnets were fixed and the armature driven at 2,000 revolutions per minute—thus getting the same result from a machine driven at a moderate speed, as one constructed on the present system driven at a very high speed, or if driven at a maximum speed obtaining twice the amount of electricity that could be obtained from one constructed on the ordinary plan. The specification also relates to the general construction of the machine. (*Provisional only.*)

2226. "Incandescent electric lamp." T. FLOYD and I. PROBERT. Dated May 11. 2d. The improved incandescent electric lamp which forms the subject of this application for letters patent is constructed as follows:—The inventors take a glass globe, either spherical or not, and provided at both top and bottom with a stem or prolongation, and, having exhausted the air from the globe, they place inside it one or more carbonaceous fibres at approximately equal distances from each other, and from the centre of the globe. These fibres are attached at each end to the opposite conducting wires of the electric source, the said conducting wires passing through the stem or prolongation of the globe. (*Provisional only.*)

CITY NOTES, REPORTS, MEETINGS, &c.

THE PHŒNIX ELECTRIC LIGHT COMPANY.

A MEETING of the above company was held at its offices in George Street, Hanover Square, at eleven o'clock a.m., on the 22nd inst., in pursuance of a notice issued by the directors, in order to discuss and pass a resolution for the voluntary winding-up of the company.

After the Secretary had read the notice convening the meeting,

The Chairman, in a few words, stated that the reasons for the proposed winding-up were the collapse in the value of electric undertakings, promises by various persons to take shares not having been fulfilled, many shareholders having failed to pay the calls, failure to dispose of concessions, and the vendor refusing to grant further time

for payment of purchase-money. The Chairman urged that the directors considered these reasons quite sufficient, and asked the meeting to carry the resolution for a voluntary winding-up, which he then moved.

The motion having been seconded,

Mr. C. P. Whiteley stated that he did not doubt but that every shareholder would agree with the directors that a winding-up was inevitable, but that, for his part, all agreement with the directors ended here, and that he would endeavour to prove that the directors were not fit and proper persons to be intrusted with the winding-up. In the first place, he protested most strongly against the meeting being called at such an unusually early hour as eleven o'clock in the morning. The offices were in the West End, and it was impracticable for many business men to get there so early, besides which many country shareholders would be able to attend only by staying the previous night in London. The reasons given by the chairman for the winding-up were not the true ones. As to the non-payment of calls there was a legal remedy, so that that excuse was a frivolous one. As to promises to take up shares not being fulfilled, he contended that excuse proved that the directors improperly proceeded to allotment on shadowy promises of support. If these promises had been *boná fide* made, why did not the directors get the persons making them to apply in the usual way and stake the application money. As to failure in disposing of concessions he remarked that the prospectus stated that one offer was actually made for Scotland alone for £40,000, and that other offers to the extent of £145,000 were under consideration. As to the vendors closing the contract he ventured to assert that it was an arranged thing in order to offer some show of excuse for getting out of liability. He asserted that the true reason for asking a voluntary winding-up was that the promoters and directors who were in the same boat, saw that they could not galvanise this corpse of a company into a semblance of vitality, that this phœnix would *not* rise from its ashes, and they wished to shirk their liability under a winding-up voluntary, that is, under their own auspices and in the way that suited them—not the shareholders. In due course he would propose an amendment, but he would first prove that the directors were not competent to distribute such assets as remained. The chairman stated that the directors had a heavy stake in the concern. Well, what was their stake? Three of them held 500 shares each, one 100 shares, another, a baronet, had risked the enormous sum of five pounds in the concern, and the remaining one the same stupendous sum of five pounds. No doubt most of the shareholders had been caught by the glowing prospectus which deliberately stated that an offer to purchase the concession for Scotland for £40,000 had been received and that further offers to the tune of £145,000 were under consideration. Now, the first issue of shares was to be £125,000. What a tempting bait! An enormous profit to start with. The directors now quietly say they have failed to dispose of any concessions. Who made the offer? Was any deposit made? If these offers were at all doubtful why were they made *the* feature of the prospectus? The prospectus held out that the business of the company would be:—The manufacture of electrical apparatus, the lighting of cities, towns and *villages* (why not go down to cow sheds at once?) in England, Scotland, Ireland, the Isle of Man and the Channel Islands, the manufacture of chemicals and the supply of motive-power. Now, then, what capital did the directors consider sufficient to carry on all this magnificent show of business? The public were allotted shares to the extent of £13,691, so that the concern was started with the sum of £13,691 as the utmost that could be received by calls to the full amount, and this would take three months at the earliest by the articles, the actual cash received on allotment, previous to calls, being £3,415. Now, the first thing to be done was to pay to the promoters, according to agreement, £5,000 for the expenses of the promotion. Next, the sum of £30,000 in cash had to be paid to the promoters as part of consideration money. How much was left to manufacture dynamos, apparatus, and chemicals, pay salaries, directors' fees, agents' commission, and travelling expenses, purchase furniture, and light up the whole of England, Ireland, &c., &c., as per prospectus? Further, we were clogged with an "old man of the sea," in the shape of a £40,000 sleeping partner, that amount being credited in shares to promoters as balance of purchase. So that the case stood thus: When we had paid £5,000 for expenses of promotion, £30,000 to promoters as part purchase, and bought office furniture, &c., we could start business; but then Mr. Promoter, sleeping partner, says: "I want two-thirds of all the profits; you who find the coin must be content with one-third." It was gross incompetence (if not worse) for our directors to start business with *no* capital—for our £13,691 belonged to promoter as part of £5,000 and £30,000—he repeated with *no* capital, a debt of £16,309, and a partner to take two-thirds of the profit. Not content with mismanaging the concern so far, the directors on the 24th June entered into an agreement with the promoter, whereby the £70,000 purchase-money was to be paid, £45,000 in shares and £25,000 in cash. What right had the directors to do this without consulting the shareholders? and ought they not to have returned the allotment money at once? It was the old story, "Don't let the money go back, we'll take anything rather than nothing." However, not content even with this the directors, having started a Bankrupt Company over head and ears in debt, plunge a little further into the mire, for on the 4th of July these gentlemen actually enter into an agreement to purchase from an Electric Light Syndicate some patent of an indefinite nature for the sum of £40,000. Where on earth was the money to come from? He had not had time to search the agreements between the vendors, promoters, and secretary, to see if the usual clause precluding the directors proceeding to allotment on an insufficient application for shares was inserted, but if these agreements permitted an allotment on £14,000 worth of shares, then there was again gross mismanagement somewhere. Now the directors asked for a voluntary winding-up. What specially prompted them to desire it to be voluntary? [illegible] asked that question was this:—He had taken the trouble to examine the register of shareholders, and in it he found Mr. Waters, the promoter, credited with 45,000 shares. This was *ultra vires* to begin with, being contrary to prospectus. He also found that Mr. Waters was debited with 27,243 shares transferred and sold to other persons, leaving only 17,757 then standing in his name. Why did the directors allow this? If the promoter had been a man of honour, he would not have parted with a single share until the company was properly and honestly floated. What did it look like? Why, that Mr. Waters saw that the bubble must burst, and took care of No. 1. £27,243 was better than nothing. If he could so readily dispose of £27,000 worth of shares, why did he not place some of the unallotted shares of the company, and so enable them to start business with some pretence to capital? No doubt Mr. Waters thought this £27,243 was safe in his pocket, but that remained to be seen. He (Mr. Whiteley) would do his best to make Mr. Waters disgorge. Another curious disclosure remained to be brought to the light. A Mr. Jabez Poulson had applied for 1,000 shares, and the directors have actually taken his promissory note for £250 for the amount of deposit and allotment money. Well, he maintained that as the directors had chosen to accept the responsibility of taking a promissory note they were personally liable for the amount. Now he was not aware how many writs had been issued against the company, but he knew that one writ had been issued against the company by a holder of 500 shares for a return of the money paid by him on the ground of misrepresentation. In order to stop these writs, and to secure a fair distribution of the assets, Mr. Hough, a large shareholder, had in conjunction with himself presented a petition for the winding-up of the company under the direction of the High Court of Justice, and that petition would be persevered with to the end in default of satisfactory terms being made with the *boná fide* shareholders. The promoters ought to return to the shareholders the whole of the money they had paid. The promoters would then only have to bear the cost of floating the company, which ought never to have been floated, and the cost of winding-up would be saved. If the petition went on the petitioners would most assuredly try to make the promoters and directors responsible personally for their misrepresentations and mismanagement. If the directors would like time to consider his proposal he would consent to this meeting being adjourned for a fortnight, but if they pressed their resolution he would move as an amendment—"That this meeting cordially supports the petition for winding-up, under the direction of the High Court of Justice, and authorises the petitioners to proceed with the petition with energy and despatch." Those shareholders who cared to give their support to the petition would incur no liability by so doing, as he was not standing alone in the matter, and he had sufficient guarantees from influential shareholders to cover expenses in the event of failure, an eventuality he did not anticipate for one moment. In conclusion he urged the shareholders not to throw in their lot with the directors, gentlemen who, however worthy they might be in the outside world, had displayed in this miserable concern such lamentable incompetence.

Mr. Tompsett thoroughly agreed with all Mr. Whiteley's remarks. The affairs of the company had not been properly started and culpable neglect had been shown by the directors. He thoroughly supported the winding-up under the direction of the Court as the only satisfactory course open to them and he begged to second the resolution to that effect moved by Mr. Whiteley.

Mr. Hough stated that the object of the petition was not to wreck the company, and if the directors could satisfy the shareholders, well and good, but if not, then the shareholders must, of course, look out for their own interests. Bearing this in mind, he thought the suggestion for an adjournment was a good one and hoped the directors would accept it.

A long discussion then took place, in the course of which the chairman stated that the amount of cash in hand was £737, but that the assets would be considerably more than this, as the vendor was bound to return the cash paid under agreement. With regard to the shares held by the promoter, the directors were awaiting legal advice as to whether these would participate in the distribution of assets. Of the shares transferred by Mr. Waters, 14,000 had been transferred to the first vendor.

After a consultation the directors decided not to press their resolution for voluntary winding-up at that meeting, and accepted the suggested adjournment. The meeting consequently stood adjourned for a fortnight.

THE FAURE ELECTRIC ACCUMULATOR COMPANY (LIMITED).—This Company offers for public subscription 25,000 Preference shares of the French Electrical Power Storage Company (Limited), at the price of £12 per share, the interest on each share being 6s., or 7f. 50c., each half-year. The Faure Company guarantees the interest, and the shares will be redeemed by drawings in 30 years at £20. The issue is made in pursuance of certain arrangements announced at the recent special meeting of the Faure Company, which M. Philippart induced the shareholders to accept. The French Storage Company have exclusive rights to the Faure patents in France and the French Colonies, and they intend to proceed on the method of granting licences to subsidiary companies, which was carried out so extensively by the Anglo-American Brush Company, and, as *The Times* remarks, "with results which are now seen to have been by no means altogether satisfactory."

REMOVALS.—The offices of the Gower-Bell Telephone Company (Limited), the Consolidated Telephone Construction and Maintenance Company (Limited), and the River Plate Telephone and Electric Light Company (Limited), have been removed from No. 6, Lombard Street, E.C., to the Telephone Works, Farringdon Road, E.C. Edison's Indian and Colonial Electric Company (Limited) has been removed from No. 6, Lombard Street, to 4 and 6, Throgmorton Avenue, Throgmorton Street, E.C.

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